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UNIVERSITY EXTENSION.

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ONE can scarcely fail to notice, in the intellectual life of America, how very rapidly a new thought sweeps across the continent. It travels with almost the speed of the whirlwind. The storm center is commonly Boston or New York or Philadelphia, and progress is toward the westward. At once the impulse is felt in Chicago and Denver and San Francisco. A new book, a new creed, or a new social ideal easily gains the popular ear. Like the Epicureans and Stoics, we delight to hear a new thing. It can not be said that this interest is always, or even generally, a profound or fruitful one. But it has at least this advantage, that it secures a speedy hearing for such ideas as are put in a form suitable for assimilation, and this alone is no inconsiderable gain.

The educational movement known as university extension is an admirable illustration of this national alertness and versatility. It is a movement capable of very definite presentation and of calling up equally definite mental images. As a result, it is now familiar in name at least to the majority of our people, and it has become so in a surprisingly short space of time. Returned travelers from England have whispered the name in private for several years past. Certain phases of the movement, such as the Toynbee Hall experiment of planting a colony of culture-loving men in the arid district of London, have for some time attracted attention on both sides of the water. But, as a distinct object of public interest and discussion in America, university extension is hardly two years old. It was not until the winter and spring of 1890 that the movement took rank as a question of the day. Outside of the larger and more interested cities, and possibly even within their borders, it may still be that the name of the move-

ment is more familiar than the idea for which it stands. It is the purpose, then, of the present article to state briefly—as becomes the importance of the subject—just what university extension is, somewhat of its history, and what claim it has for a permanent place in our intellectual life.

University extension has been well defined as a university education for the whole nation by an itinerant system connected with established institutions.

I confess that this sounds ideal, the proposition to educate the whole nation on higher lines, but that is precisely what the movement means. It means that any one in any place and at any time may take up advanced work in any department of human knowledge, and that qualified men stand ready and willing to help him. I feel that this is a most significant statement—so significant, indeed, that I may be pardoned for having said the same thing twice.

Our people as a whole are not intellectual and are not culture-loving. They are not given to what Emerson calls the reasonable service of thought. The majority of them are the servants of a much less noble master. It can not be expected, therefore, that so large an idea as forms the germ of university extension will meet with anything like immediate fruition. But it is a leaven which is well worth setting to work. The success of the movement is already well enough assured to demonstrate that in any community there are unsuspected numbers with a turn for higher education, and such an attitude of mind is apt to spread.

That is the end—to permeate the nation, the whole American people, with a taste for culture, and then to provide means for satisfying it. It is admitted that such a taste does not generally exist, but it is believed that it can be brought into being. No right-minded person, I think, will quarrel with this purpose, provided it can be shown that the proposed culture is genuine and not merely a veneer. The method, too, is correspondingly simple, and it seems to me quite adequate. It would be an impossible task to civilize all America at once. The Philistine element is much too strong for that. If the movement attempted such a task it might well be regarded as overly optimistic. But it is really as practical in its methods as a paper-box factory. It is going to attempt no regeneration in the lump, nor to force its wares where they are not wanted. What it is doing and going to do is simply this, to put the higher education within reach of those who care for it, and through these to stimulate others also to want the same thing. It might be well described as a missionary movement conducted on scientific principles.

Unharnessed to events, the scheme would read somewhat like a dream. It will be better, then, to give an account of it by telling

just what is being done in England, and what is being done and planned in America. It is well to begin with England, as being the older and better organized field. For my knowledge of the work there I am indebted to the conversations of friends who have attended the Oxford meetings, and to various reports and pamphlets, but most of all to an admirable little book on University Extension by Messrs. Mackinder and Sadler, which I would strongly commend to those who care to go further into the details and history of the English movement.

The work in England is divided among four organizations: the London Society for the Extension of University Teaching, the University of Cambridge, the University of Oxford, and Victoria University. While there may be some friendly rivalry as to which shall most abound in good works, it must not be thought that the organizations are in competition with one another. This would indeed be impossible in the case of the London Society, since its staff of lecturers includes those of both Cambridge and Oxford as well. The chief business of these central offices is to provide lecturers and to arrange courses. It must be constantly kept in mind that they are essentially teaching organizations and by no means mere lecture bureaus. It is true that university extension does not disdain to present knowledge in an attractive form. It makes an admitted effort to be entertaining. But this is only a means to an end. The main object is more serious, and consequently no course is ever given on miscellaneous topics. The unit consists of twelve weekly lectures on one approved subject. Such a course, therefore, covers three months and constitutes one term in the extension work. There are two a year, the fall and spring terms, separated by the Christmas holidays. Now that the movement is well established, a strong effort is being made to bring the studies into close educational sequence, and to have the work of succeeding terms continue what has been done previously. This is not always possible, for university extension studies are strictly elective and are never administered in prescribed amounts. But it represents the ideal and the more intelligent students clearly see the advantage of continuous and related work in place of indiscriminate browsing.

The central offices do not, however, assume the initiative. They are the agents and inspirers of the local centers. The movement generally starts in any given neighborhood by the interest and effort of one individual, or perhaps by the concerted action of several. The known friends of education in the locality are called upon, and the question of forming a center discussed. If the scheme seems feasible, a public meeting is arranged, great care being taken that it shall have no religious, political, or class

coloring. A speaker goes to them from one of the universities and explains the extension plan. If the impression produced be favorable and the question of ways and means do not hinder, the meeting results in the formation of a local center, and a permanent secretary and a board of managers are appointed. A subject is then chosen, and application made to one of the central offices for a lecturer. In many cases a particular lecturer is asked for, as the extension men are coming to have pretty widely known reputations, and the public naturally selects the most popular. The question of finance now comes in. The universities supply qualified lecturers, arrange courses, and hold examinations, but the expenses must be guaranteed by the local centers. The work does not pay for itself, but then no scheme for higher education ever does. The receipts from the sale of lecture tickets may generally be counted upon to meet half the expenses of the course. The rest must be provided for in some other way, commonly by subscriptions or by some larger benefaction. The university fee for the twelve lectures is about £45, and the local expenses will generally amount to about £20 more. This is for a single course. Where more than one course is taken, the proportionate expense is somewhat less.

In most cases the local center is an outgrowth from some library association or institute, and has already much of the needed machinery in the way of hall and books. The course is duly advertised and as strong a local interest enlisted as possible. The audience is made up of all classes, the more miscellaneous the better. The extension movement recognizes no class distinctions. It includes the gentry, mechanics, school-teachers, barristers, tradesmen—all, indeed, who will come. The work differs from that of the school, as it is primarily for the education of adults, and its methods have men and women in mind as the material.

And now the lecture begins. It lasts for about an hour, the lecturer endeavoring not so much to present the whole of the subject-matter of the evening as to give a distinct and helpful point of view from which his hearers may look at it for themselves. It seems to me that this is a most hopeful feature of the extension work, and one which brings it into direct line with the best of modern educational practice. It is the spirit of the new education to proceed always by appealing to the self-activity of the taught rather than simply to their capacity for receiving.

If the lecturer be skillful, the hour seems very short, for the feeling is abroad that here is a man thinking out loud and suggesting a whole lot of new thoughts which will make one distinctly the richer. It is a pleasant sensation, recalling the very cream of

bygone school days, and it shows itself in rows of flushed and grateful faces. An essential part of the lecture scheme is the printed syllabus, which is supplied at merely nominal price. This gives the systematic outline so needful to the student, yet so uninspiring in the lecture itself. In addition, the syllabus suggests a careful line of home reading in connection with each lecture. The lecturer also gives out one or more questions which are to be answered in writing and mailed to him some time before the next lecture. This home paper work is regarded as of the utmost importance, since it brings out the thought and originality of the student in a way that a simple lecture never could.

When the lecture is over, a class is formed of all those who care to enroll themselves as students, the other hearers withdrawing. The class lasts for about an hour, and also ranks above the lecture in educational importance. It is here that the personal intercourse between lecturer and students comes into play. It is, indeed, very much like the college seminar, and is as conversational in its tone as the bashfulness of the students will allow. The lecturer develops his points a little further, and explains any difficulties that may have arisen. He also uses the occasion to return the written exercises, and makes such criticisms and comments as he thinks best. Often, misapprehensions are to be corrected, and false views pointed out. Frequently there is the more agreeable task of reading some particularly good answer, and acknowledging the justness and perhaps the originality of a student's comment. In all cases no names are mentioned, and great care is taken not to wound the sensitiveness of any one. The sharper tools of irony and satire are always contraband.

One can readily see how much depends upon the personal qualities of the lecturer. He must, indeed, be a man out of a hundred, a well-qualified specialist, a brilliant speaker, and, above all, a man of much fine tact and discretion. Each organization has its regular staff of lecturers, who hold, in most cases, some other appointment, and give only a portion of their time to extension work. A few, such as Mr. R. G. Moulton, of Cambridge, and Rev. W. Hudson Shaw, of Oxford, devote themselves exclusively to the movement, and are its most successful exponents. But many promising young men have also been attracted to extension work—some through a genuine missionary interest in the spread of culture, and some for less disinterested motives. It is not, however, a proper field for experimentation. The work is difficult and needs men of known ability. The universities try to guard against failure by duly testing the capabilities of all young aspirants for lecture appointments. While it is most unfortunate when the wrong man does get into the work, the mischief is soon remedied, for his lack of success leaves him in a very short time

quite without engagements. In the lecture world there is a manifest survival of the fittest.

When the course ends there is a formal examination, open to all students who have attended a specified proportion of lectures and done the requisite home work. Certificates are awarded to the successful candidates, the results depending upon the term work as well as the examination. I have not myself much faith in academic labels, but these certificates have a certain value in stimulating the students to carry their work to completion.

Where university extension is still untried, half courses, of six lectures each, are sometimes given by way of experiment, but in this case no examinations are held and no certificates are awarded.

The statistics of the movement show that it is still increasing in popularity. All of the numerals which sum up its activity, attendance, lecturers, courses, have much more than doubled within the past five years. The figures of 1889–'90 show that nearly four hundred courses were given, and that these were attended by over forty thousand people. During the winter of 1890–'91 the attendance was over forty-five thousand. It is estimated that about ten per cent take the examinations. A number of new and interesting developments have attended this growth. Besides the regular fall and spring terms there are also summer meetings at both Oxford and Cambridge, which have been a most pronounced success. One can scarcely overestimate the advantage of even this brief residence at the universities themselves. It is no inconsiderable education simply to be in Oxford. The tastes which are thus encouraged make possible better things in the winter courses following. The Cambridge summer meeting is, on the whole, more scientific in its scope, and the numbers in attendance are consequently small, but are increasing as the opportunity becomes better known.

At Oxford the meetings have always been of a more popular character. The students are numbered by hundreds and even of late years by the thousand. The meetings only began in 1888, when the session lasted for but ten days. Yet there were nine hundred students present. Since then the sessions have lengthened and the attendance has likewise grown. For obvious reasons the students are largely drawn from the teaching class, the greater number being women. The opportunity of hearing such men as Max Müller brings even an increasing company of Americans to these summer meetings.

While the expense is kept as small as possible, the question of ways and means is too much for many of the poorer extension students, and scholarships are being founded to enable these to taste Oxford for at least a few weeks.

There are many other features of the English work, such as

students' associations, home reading circles, traveling libraries, and the like, which are doing much to extend its influence and render the movement permanent. One of these features, the scheme of affiliating students to the universities, deserves special mention. What the universities have been working for all along is the promotion of serious and continued study. Where this was out of the question, they did what they could, and tried to stimulate the neighborhood to something better. The work has now progressed far enough for them to offer a systematic course of study covering four years, and having a definite end in view. The students who take eight unit courses in related subjects approved by the management, and who do the home work and pass the examinations successfully, receive the title of S. A.—affiliated student—and have the privilege at any subsequent time of remitting one year's residence at Cambridge, and so completing their studies there in two years. In the majority of cases two years would be quite as prohibitory as three, since the students are no longer young, and are already pledged to some career in life. Yet affiliation is held to be a great good, for it brings system and continuity into extension work, and makes a closer and more vital bond between the universities and the people.

If we come now across the ocean to our own country we shall find, considering the newness of the movement here, a development of the university extension idea even more surprising than in England. It is a large tribute to the catholicity of this idea that it stands transplanting so admirably. The needs of the human spirit are much the same in all countries. What is deepest in us and best is essentially cosmopolitan. The extension scheme is distinctively English in its origin, yet it has needed surprisingly little adaptation to fit it to American conditions. Perhaps the chief differences in condition are geographical. Life is more concentrated in England than with us, and the main changes will have to be in deference to our magnificent distances.

In certain quarters the importation of a British idea is resented almost as warmly as if the article were a steel rail or a durable cloth. In others, again, it is said that we have had university extension in America for many years, and we are pointed to the lyceums of New England and to Chautauqua. These institutions have undoubtedly done admirable work, but they are not university extension, and it is no discredit to them to say so. I have no particular desire to represent the movement as unique. It would be seriously misrepresented, however, if the impression were allowed to become current that university extension is simply a duplication of educational machinery already in successful operation. It is not. It is a movement with a new end, the populari-

zation of higher university education, and it proceeds by a new method, the personal carrying of this teaching from the universities to the people. It is held to be more practical to take one man to a hundred students than to take a hundred students to one man. It is important to keep this object and this method free from any confusion with other organized work, for the usefulness of university extension lies in these lines, and not as a competitor with already established agencies of culture.

It is somewhat difficult to tell the story of university extension in America, for the idea sprang into action in a number of different localities. Without attempting to present the full history of the movement, it may be said that three distinct ideals have been advanced—the local plan, represented by Baltimore and Buffalo; the State plan, represented by New York; and the national plan, represented by Philadelphia.

The local plan is the oldest. Its first home seems to have been at Johns Hopkins University. Several years ago popular lecture courses were given by Dr. Adams and his colleagues at various centers in and around Baltimore, and as time went on the movement assumed more and more the form, and finally the name, of university extension. Several such courses were given during the winter and spring of 1888. The method was quite similar to that followed in England. The course consisted of twelve lectures, followed by the customary extension classes at their conclusion. The students were supplied with printed syllabi of each course. Dr. Adams also rendered a most important service to the movement by his interest in making it more generally known outside of his own city. Similar initiatory work was done by Dr. Bemis at Buffalo. In the fall of 1887 he gave a course of lectures on economics, which were quite in the extension spirit.

The State plan is, I believe, peculiar to New York. It would, indeed, be less possible elsewhere, since New York is the only State which has a department created and maintained by statute to "encourage and promote higher education." The movement has had the constant interest and support of the best element in both the city and State. The State Librarian, Mr. Melvil Dewey, has been particularly active in its promotion. According to this plan, the State assumes the direction of university extension, working by means of an established central office at Albany, and operating through existing institutions for higher education. The Legislature has recently granted an appropriation of ten thousand dollars for carrying on the enterprise. Already much good work has been done in the way of lecture courses and printed syllabi and text books.

The national plan has been a slower evolution. It is an out-

growth of the local society at Philadelphia. The history of this organization is sufficiently typical to warrant its statement in some detail, the more so as its aims are now national. The idea of university extension was not known to the city at large until the winter and spring of 1890. It aroused so much interest, however, that the public discussion of the question led to the formation of a society on the 1st of June. Dr. Pepper, the Provost of the University of Pennsylvania, became its first president, and Mr. George Henderson was chosen secretary. The society at once went to work in a most practical and business-like way. It was recognized that two things were wanted—more definite information in regard to what was being done in England, and also the interest and co-operation of educators connected with neighboring teaching bodies. Accordingly, the secretary was sent to Europe, and in the fall presented a report of what had been accomplished there. Further, a circular letter addressed to the available teachers of the locality assured the society of a sufficient staff of lecturers. These ends gained, the work of the society began last fall in earnest. The first local center was at Roxborough and was organized in connection with St. Timothy's Workingmen's Club and Institute, which was already provided with an excellent hall and well-selected library. The subject chosen was chemistry, the first lecture being given on November 3d. The formation of centers and the announcement of courses soon became epidemic. By spring it was a rare thing to find any one among the more thoughtful classes who had not attended at least one extension lecture.

In the one season forty-two courses were given, numbering about two hundred and fifty lectures. The total attendance was about 55,500, a result unparalleled even in England.

Numbers alone are a very bad standard for an educational movement, but figures such as these indicate at least a wealth of teachable material. The success has indeed been beyond the most sanguine expectation. The idea is, I believe, due to Dr. Pepper that so vast a movement as this should properly be a national interest, and without local bounds. In December, therefore, the society changed both its name and its purpose, and became the American Society for the Extension of University Teaching.

The work in England, it will be remembered, is divided among four organizations, and there are advocates of this separation as well as of unification. Here in America the movement is just beginning, and we are called upon to choose. It must not be understood that the three plans mentioned are in any way antagonistic or are meant to compete with one another. They are the natural products of the different conditions under which they

have grown up. The only question is as to which plan will best serve the cause of culture. There is much to be said for all of these ideals, but it seems to me that the balance is indisputably in favor of the national plan. Already the American Society has extended its operations outward from Philadelphia as a center for upward of one hundred and fifty miles, and its purpose is to reach from ocean to ocean. A large step toward nationalization has been taken in the West. The extension work in Colorado, centering about the University of Denver, and perhaps the immense work planned for Chicago, will become branches of the American Society. It is also hoped that association may be brought about with the New York work. By bringing all these movements into one organization there will be greater administrative economy and greater system in the educational results.

What has been already accomplished by the National Society makes entirely reasonable the large plans which it has in mind for the future. The acting president of the organization is now Prof. E. J. James, who has associated with him educators of foremost rank from all sections of the country. It is proposed to utilize every feature which experience in England has shown to be helpful. The success of the American Society is indeed largely due to the fact that it has done little useless experimenting. The first season is always critical, but the movement had the large advantage of the constant service and counsel of Mr. Moulton. His many years' experience in the English work made him invaluable here. During nearly the entire season he lectured afternoon and evening in Philadelphia and its suburbs as well as in other American cities. He will be followed winter after next by the Rev. Hudson Shaw.

Now that university extension is well launched in America, it is hoped to offer more thoroughly systematized courses of study than was possible during the first season. A journal known as University Extension has been established, and issued its first number in July. Summer meetings will also be arranged, preferably at different university towns throughout the country. It is further proposed to introduce the plan of affiliating students to the universities, or even to go further than this, and finally to offer full courses leading to university degrees.

A most important and indeed an integral part of the work will be in the line of encouraging home study, and a well-thought-out plan has already been adopted. This provides a systematic course for that vast number of solitary students who can neither attend a university nor even form an extension center, but who are well worthy of the attention of a society committed to the cause of general culture. As at present arranged the courses cover four years of seven months each, or twenty-eight months

of study in all, and are strictly along university lines. It is true that these students lose the large gain which comes from personal intercourse with the teacher, but they are in constant communication with him, and by his letters and printed notes he can be an immense help in the way of stimulating and directing. At the end of four years a regular examination will be held. Those who pass it successfully and whose progress during the course has been satisfactory will be awarded a certificate which it is the purpose of the society to make of recognized value.

It is, then, an almost realized dream that any one in any place whatsoever may have the advantage of university education. It is a mistaken idea altogether, and one that has robbed the race of much progress, that education ends when maturity begins. By that time one has only gathered a few of the materials of culture. A grown-up man or woman with a book in hand for the purpose of serious study is in too many American communities almost an anomaly. But we have now fallen, it is hoped, upon better days, and the education of men and women has become a national purpose.

When a rich man founds an institution, erects substantial buildings for its accommodation, and bestows his name upon it as well as his money, public attention is arrested, for there is something visible and tangible for comment to spend itself upon. But right here, in our very midst, there is growing up a university more vast, I am bound to believe, than any of these extensive benefactions, and one destined to make a more profound impression upon the intellectual life of America than has yet been made. It is a university whose strength lies in this, that its students are as miscellaneous as society itself; that it is bound to no creed, no class, no party, but is committed only to the service of truth—not truth as you or I see it, or as any particular body of men see it, but to that increasingly transparent vision of truth which comes to humanity as a whole. Nor is the purpose of this university defeated by distance and railroad fares. It is the guest of every man or woman who will make it welcome. Neither does it demand what so often can not be given, one's entire time. Its duties may be fulfilled at odd moments, at any time as well as at any place.

To carry out so vast a purpose as this is going to take a proportionate number of men. And to do it thoroughly, on the high plane which is promised, is going to take thoroughly equipped men. It is still an open question as to just how this need shall be supplied. All the lecturers so far, with the exception of Mr. Moulton and possibly one or two others, have been men holding positions in established institutions, and this has had its advantages. The men bring the experience and the disciplined spirit of

the class-room with them and teach as well as lecture. And the effect upon the men is good too. The human element in them grows, and this without loss of scholarship. But so large an undertaking as this can not obviously take second place in the consideration of its agents. As time goes on, the staff of lecturers will probably include an increasing number of men who give their entire time to extension work.

It might be well if a man could alternate between resident and itinerant duty. Perhaps this would save him from that intellectual stagnation which is one of the chief dangers of the professorial chair. At present it seems to me that our universities are too much the asylum of men who nurse rather than use their scholarship, or who give their best energy to original research and throw only an occasional crumb to those who are pleasantly called their students. In all but the largest institutions one man has generally to teach several branches of his subject. If he did both university and extension work, he might devote himself to one particular branch and get better results in both fields. Prof. Johnson used to say that he wished there might be a professor for each chemical element, and he would like to be Professor of Iridium. But this is a matter which may safely be left to experience.

Besides the men, money is needed. So far, the work of the society has been paid for by the annual membership dues of five dollars, while each local center has met the expense of its own courses. The lecturer's fee is always fifteen dollars a lecture. This is paid to the central office by the local center, the lecturer having no direct business relations with the people to whom he goes. The incidental expenses of the course, varying with the locality, are met by the local management. Extension work may thus be undertaken by any university which will devote a little of the time of its secretary to the purpose, and by any local center which can raise the fee for a course of six lectures, ninety dollars, and provide for incidentals. It will thus be seen that very little money is required to make the experiment of an extension course. In some instances the local centers have had a considerable balance at the end of the season. But this has been due to the fact that only popular subjects have been chosen. It has been the experience in England, and it will undoubtedly be the experience here, that the more systematic and satisfactory work will not pay for itself. Some outside revenue must be looked to.

In England, several plans have been tried and proposed. In some cases a fixed subscription, as with the American Society, supplies the needed funds. In others, associations are formed and shares offered for sale, while still others depend upon private munificence. But all these resources are transient, and place the

work much at the hazard of changing fortunes. A better financial basis is wanted. It has, therefore, been proposed to attempt to secure endowment, through personal benefactions, by the definite assignment of university funds, or through state aid.

Sooner or later the same problem must be met here in America. Sufficient funds have been forthcoming to start the movement and carry it through a highly successful season. That was the main thing. The good gained is now to be secured and extended. To do this it is very desirable that the revenues shall not be precarious. The present source of income, by subscriptions, will keep the movement alive, but it will not allow that more comprehensive policy which seems so desirable. Private endowment has already done something and will probably do more, as the opportunities for good become known.

The possibility of enlisting Government aid opens a larger question. University extension is a national movement which is intended to reach all classes and to promote the most vital interests of the nation. It has, then, as large a claim upon the national pocket-book as any interest which the Government can recognize. The States provide for primary and secondary education; the nation might well provide for the higher culture. It seems to me a possible and in many ways a highly desirable scheme that with the unification of university extension into one national society, and the division of the country into suitable districts, the work should assume a truly national character and should be brought into close relation with the Department of Education at Washington. The commissioner might have his representative in each extension district, and the local office thus organized would not only be the center of the extension work in the district, but it could also render material service in the collection of educational statistics, and in bringing the department into more vital touch with the schools of the country. In this way we should have a university coextensive with America, a truly national university, since it would include the entire people, and one which would be a much greater power for good than the elaborate institution which is dreamed of for the capital city.

It is a commonplace that the most vital interest of America is the education of her citizens, and that her greatest danger lies in the disintegrating force of ignorance within her own borders. But this largest interest, both in point of power and of danger, is given secondary place in the national councils. We have a Secretary of War, of the Navy, of the Treasury, and of such material interests, but we have no Secretary of Education. With the elevation of the commissioner to the place of a cabinet officer, the new portfolio would be well charged with power if it had linked to it the destiny of a work of such magnitude and promise as uni-

versity extension. We should then be committed as a people in very practice to what we now profess only in theory, to the enlightenment and elevation of the whole nation. There are doubtless difficulties and objections in the way of carrying out the suggestion here brought forward; but, when the evidence for and against is duly considered, I believe that the balance will be found much in favor of such a nationalization of the extension movement.

As I set down in formal order these statements concerning the achievements and potentialities of university extension, I feel again the deep enthusiasm which was aroused by a first acquaintance with that large idea for which the movement stands. The attempt to realize this idea has had mixed with it somewhat that was unworthy. There has been a manifest tendency to estimate its worth by the common American standard of numbers. That thousands should listen to a popular extension lecturer was counted success; and men have gone into the work for the admitted purpose of advertising themselves and their branches. But these are the accidents of the movement. Under them there is an essential principle, a working idea, which has in it immense promise.

As a people we greatly need the leaven of a higher purpose. The ideal of life most current has in it much that is sordid and mercenary. Here is an opportunity to present a more worthy ideal, to substitute for the popular self-assertion a spirit of greater teachableness. We have not yet reached a point where we can impose our ideas upon the world-spirit, however vainglorioously we may try. They are not worthy. They must needs be renovated and transformed before they deserve permanence. The greatest claim which the extension movement can have upon thoughtful people is that it is an organized crusade against that current Philistinism which devotes the social opportunity known as America to lower motives and ends than are worthy of it. It is a mistake to suppose for an instant that the public schools of the country will ever save us from the utterly commonplace, or to fancy that the higher education is an expensive luxury which we can quite as well do without. On the contrary, it is just as much a necessity as the elementary training. It is essential to have good foundations, but, if we all went to building cellars and stopped there, we should never have any cities. We need the higher education in America, and we need it in large measure, for we are a people with a large opportunity. And we need it particularly now, for the grave problems which press upon us for solution will demand a tolerance and large-mindedness which come only when the human spirit is well disciplined. We have here a great and busy people, but a people too unimaginative and too

unideal. We need the infusion of a spirit of culture into the national thought and life, if we are to realize the destiny which seems possible to us.

The preaching of Peter the Hermit aroused all Europe. The present occasion is less picturesque, but the crusade which it preaches stands for interests much more vital than the recovery of Jerusalem.

THE DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS.

IX. THE MANUFACTURE OF STEEL. (*Concluded.*)

By WILLIAM F. DURFEE, Engineer.

WHILE the Englishmen, Bessemer and Parry, and the American, Martien, were experimenting in England, the germ which they were trying to develop into vigorous life had been discovered in America; for the evidence is unimpeachable that the late William Kelly had been for several years experimenting in the same direction as his English contemporaries. We are indebted to Mr. James M. Swank for securing a description of these experiments from Mr. Kelly himself; and the reader who desires to see the most complete account yet published of them will find it in Mr. Swank's Iron in all Ages.

Mr. Kelly and his brother bought the Eddyville Iron Works, in Kentucky, in 1846. Their product was pig metal and charcoal blooms. As a result of close study, the idea occurred to Mr. Kelly that in the refining process fuel would be unnecessary after the iron was melted, if powerful blasts of air were forced into the fluid metal, for the heat generated by the union of the oxygen of the air with the carbon of the metal would be sufficient to accomplish the refining. He first built a small blast-furnace, about twelve feet high, in which to test this idea. The furnace had two *tuyères*, one above the other, the upper one to melt the stock, and the lower to convey the blast into the metal. He began his experiments in October, 1847, but was interrupted by other work, and did not find time to take them up again till 1851. Finding that this furnace was not capable of melting the iron properly, he decided to separate his refining process from the melting operation, and take the metal already melted from the blast-furnace. In these experiments he was endeavoring to produce malleable iron.

"With this object in view," says Mr. Kelly, "I built a furnace, consisting of a square brick abutment, having a circular chamber inside, the bottom of which was concave like a molder's ladle. In the bottom was fixed a circular tile of fire-clay, perforated for

tuyères. Under this tile was an air-chamber, connected by pipes with the blowing-engine. This is substantially the plan now used in the Bessemer converter. The first trial of this furnace was very satisfactory. The iron was well refined and decarbonized—at least as well as by the finery fire. This fact was admitted by all the forgemen who examined it. The blowing was usually continued from five to ten minutes, whereas the finery fire required over an hour. Here was a great saving of time and fuel, as well as great encouragement to work the process out to perfection. I was not satisfied with making refined or run-out metal; my object was to make malleable iron. In attempting this I made, in the course of the following eighteen months, a variety of experiments. I built a suitable hot-blast oven; but, after a few trials, abandoned it, finding the cold blast preferable, for many reasons. After many trials of this furnace I found that I could make refined metal, suitable for the charcoal forge fire, without any difficulty, and, when the blast was continued for a longer period, the iron would occasionally be somewhat malleable. At one time, on trying the iron, to my great surprise, I found the iron would forge well, and it was pronounced as good as any charcoal forge iron. I had a piece of this iron forged into a bar four feet long and three eighths of an inch square. I kept this bar for exhibition, and was frequently asked for a small piece, which I readily gave, until it was reduced to a length of a few inches. This piece I have still in my possession. It is the first piece of malleable iron or steel ever made by the pneumatic process."

Although not giving up the idea of making malleable iron, Mr. Kelly now proceeded to utilize his invention so far as it was a complete success. He built a converter, five feet high and eighteen inches inside diameter, with the *tuyère* in the side. In this vessel he could refine fifteen hundred-weight of metal in from five to ten minutes, effecting a great saving in time and fuel. After a few days' trial, the old, troublesome "run-out" fires were entirely dispensed with. "My process," says Mr. Kelly, in the account above quoted, "was known to every iron-maker in the Cumberland River iron district as 'Kelly's air-boiling process.' The reason why I did not apply for a patent for it sooner than I did was that I flattered myself I would soon make it the successful process I at first endeavored to achieve—namely, a process for making malleable iron and steel. In 1857 I applied for a patent, as soon as I heard that other men were following the same line of experiments in England; and, although Mr. Bessemer was a few days before me in obtaining a patent, I was granted an interference, and the case was heard by the Commissioner of Patents, who decided that I was the first inventor of this process, now

known as the Bessemer process, and a patent was granted me over Mr. Bessemer."

There has been a feeling among metallurgists in both hemispheres that William Kelly's claims as an originator of a process similar in all its essential features to that invented by Henry Bessemer rest on a very unsubstantial foundation of experimental facts and experience. This impression is entirely erroneous, as was proved in the interference proceedings before the Commissioner of Patents, pending the issuance of a patent to Kelly (June 23, 1857); and again in 1870, when the question of granting an extension of Bessemer's patent (of November 11, 1856) was before the United States Patent Office, the commissioner refused to grant such extension, holding that the patent should not have been issued, as William Kelly was the prior inventor; and still again, when in 1871 William Kelly's patent was extended for seven years, it having been proved to the satisfaction of the commissioner that he had not been sufficiently remunerated for the invention; and yet again, by the fact of royalties having been regularly paid by the manufacturers of steel during the whole of the seven years for which Kelly's patent was extended, for the right to use his invention; and so unimpeachable was the evidence on which his claims were founded, that there was no attempt to set them aside during that time.*

The plain, straightforward statement of Mr. Kelly above quoted is an additional proof that he was no mere schemer or dreamer. It is evident that he had a definite end in view—the making of malleable iron—and had he possessed more capital and been situated where he could have availed himself of the best facilities, it is quite probable that he would have arrived at that end by the employment of methods and apparatus which would have left little to be desired; but, located in a small community (Eddyville had not five hundred inhabitants), in a part of the country remote from the best mechanical appliances and with limited means, it is remarkable that he carried his invention as far as he did before the heavy hand of bankruptcy crushed alike his ledgers and experiments.

As matters stood when Kelly's patent was issued, Bessemer had received a patent for the same invention, and at a later date a number of patents for apparatus the design of which was clearly very far in advance of anything accomplished by Kelly. Joseph G. Martien also had obtained a patent (February 24, 1857) for sub-

* In this connection it is proper to note that all the profits which the owners of the patents of Bessemer, Kelly, and Mushet ever received were earned and divided during the seven years covered by the extension of the patent of William Kelly; and had not that extension been granted, the parties who had put their money into the purchase of these patents would never have received one cent for their investment.

stantially the same claims as he had patented in England; but, so far as can be ascertained, he made no attempt to work his process, having become convinced that the inventions of Bessemer and Kelly were much more practical and really of an earlier date.*

On May 26, 1857, Robert F. Mushet, son of David Mushet, the famous Scotch metallurgist, obtained an American patent for the addition of a compound of iron, carbon, and manganese to cast iron in the process of making malleable iron and steel. Previous to this invention neither Bessemer nor Kelly had secured uniform product; and in fact Kelly had in only a few instances been able to make a malleable metal. Mushet's invention, therefore, became at once of controlling value as respects the new method of manufacturing steel.

Early in the year 1860 the attention of the late Zoheth Shearman Durfee † was attracted to the Bessemer process. Having become convinced of the great value of the process claimed alike by Bessemer and Kelly, he induced the late Captain E. B. Ward, of Detroit, to join him in obtaining control of Kelly's patents, and of the American patents of Bessemer's apparatus and process, and of Mushet's manganese mixture. In 1861 Mr. Durfee went to Europe and spent several months in studying the practice of making "Bessemer steel" in England, France, and Sweden. After his return he and Captain Ward, in May, 1863, organized "The Kelly Process Company," admitting Daniel J. Morrell, of Johnstown, Pa., and William M. Lyon and James Park, Jr., of Pittsburg, Pa., to an interest in the enterprise.‡ Although Mr. Kelly

* Under date of May 29, 1857, Martien wrote to Messrs. Munn & Co., the solicitors of William Kelly, a most generous letter, in which he abandons all claim to precedence in the invention. The following is an extract from this letter: "I have found and have been made perfectly satisfied, from the ample testimony laid before me in the case, that Mr. Kelly is honestly the first and original inventor of the said process of manufacturing iron without fuel. I find, moreover, that he has quietly been and is making improvements and advancing with his invention in a very praiseworthy manner, and of which the public will be put in possession in a short time."

† The late Z. S. Durfee was born in Fall River, Mass., on April 22, 1831, and died in Providence, R. I., June 8, 1880. He was a practical worker in iron and steel, and I claim that he was the first business man in America to fully appreciate the great value of the new process. He manifested the faith that was in him by a persistent effort to secure its adoption, and, had his views been supported by his business associates, the manufacture of steel by the pneumatic process would have been both a technical and commercial success in the United States many years earlier than it was.

‡ These gentlemen were selected because of their well-known business ability and their influential association with or ownership of some of the largest and best-appointed iron and steel works of the country, and it was confidently expected that they would take a lively interest in the new process by promptly employing it in the works with which they were identified, and that their example would be very generally followed by the larger iron and steel works of the United States. In this expectation Captain Ward and Z. S. Durfee were greatly disappointed, as neither Mr. Lyon nor Mr. Parke ever adopted the process in their works, and Mr. Morrell only succeeded in overcoming the objections of his associates

was not included in this company, a certain interest in any profits which it might make was guaranteed to him. Mr. Z. S. Durfee soon went to England again to arrange for the control of the rights of Bessemer and Mushet in America. He was unsuccessful in the former case, but obtained, October 24, 1864, control of the American patent for the use of *spiegeleisen*, as Mushet's triple compound was called, on terms which admitted Robert F. Mushet, Thomas D. Clare, and John N. Brown, of England, to membership in the company; and on the 6th of September, 1865, it was further enlarged by the admission of Charles P. Chouteau, James Harrison, and Felix Vallé, all of St. Louis, Mo.*

While Z. S. Durfee was on his first visit to Europe, the writer of these papers was invited by Captain Ward to design and erect an experimental plant to determine the possibility of making a good steel by the new process from Lake Superior iron. I accepted the invitation, and reached Detroit, Mich., on the morning of July 1, 1862. It was decided to construct a blowing engine, and a converting vessel large enough for producing steel on a commercial scale, with reference to their use in a works properly planned for economical administration and production should the experimental works justify such an enterprise. As to the rest of the plant, it was decided to construct it as cheaply and simply as would answer the purpose of the experimental works only, and it was further decided that the experimental plant was to be located adjacent to, and partly in, the building of the Eureka Furnace at Wyandotte, Mich., about ten miles from Detroit, where Captain Ward had extensive rolling-mills. The metal for the experiments would be taken direct from the blast-furnace, and the *spiegeleisen* was to be melted in crucibles.

As soon as this general scheme was fixed upon, I began my plans for carrying it out. But very little guidance was obtainable in this task. I had never seen any apparatus for the manufacture of steel by the method proposed, and the description of that used by Mr. Kelly convinced me that it was not suited for an experiment on so large a scale as was contemplated at Wyandotte. As it was confidently expected that Z. S. Durfee would be able to purchase Bessemer's American patents, it was thought only to be anticipating the acquisition of property rights to use his inventions. I accordingly procured copies of his patents,

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in the Cambria Iron Company (of which he was general manager) in such time as to enable him to commence making steel eight years after he was admitted as a member of "The Kelly Process Company."

* These gentlemen were owners and operators of large iron-works; and, although their admission as members of "The Kelly Process Company" was with the expectation that their example and influence would promote its interest, they did not erect steel-works, and the company was in no way strengthened by their connection with it.

which, together with the description contained in the first edition of Fairbairn's History of the Manufacture of Iron, embraced all

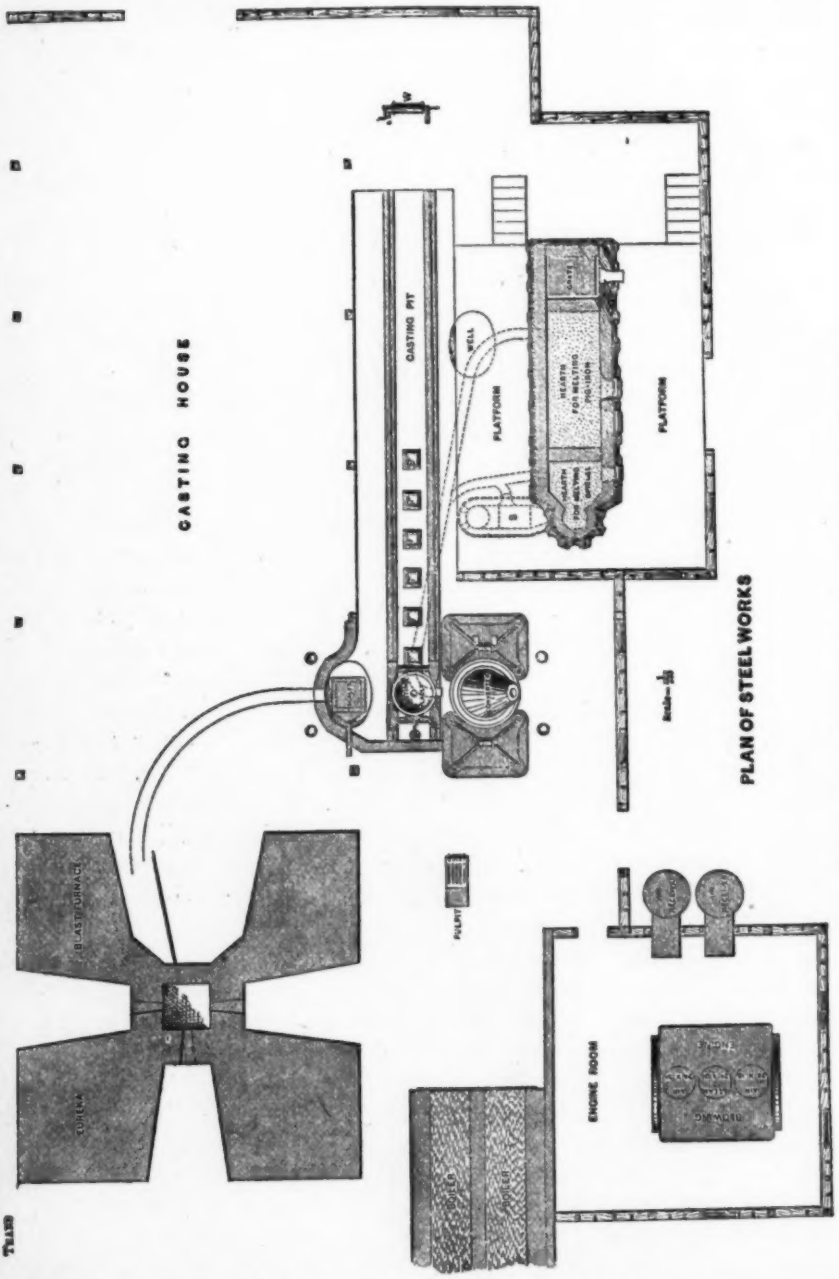

FIG. 60.—PLAN OF THE EXPERIMENTAL STEEL WORKS AT WYANDOTTE.

the information then accessible to me relative to the European practice of the new art.

Difficult as my task was, it was made almost insupportably burdensome by the outspoken opposition of nearly every influential person in Wyandotte. Nevertheless the work progressed, so that on the return of Z. S. Durfee from England in September, 1862, I was enabled to show him the "converter" nearly complete, and was greatly pleased to hear him say that it "looked

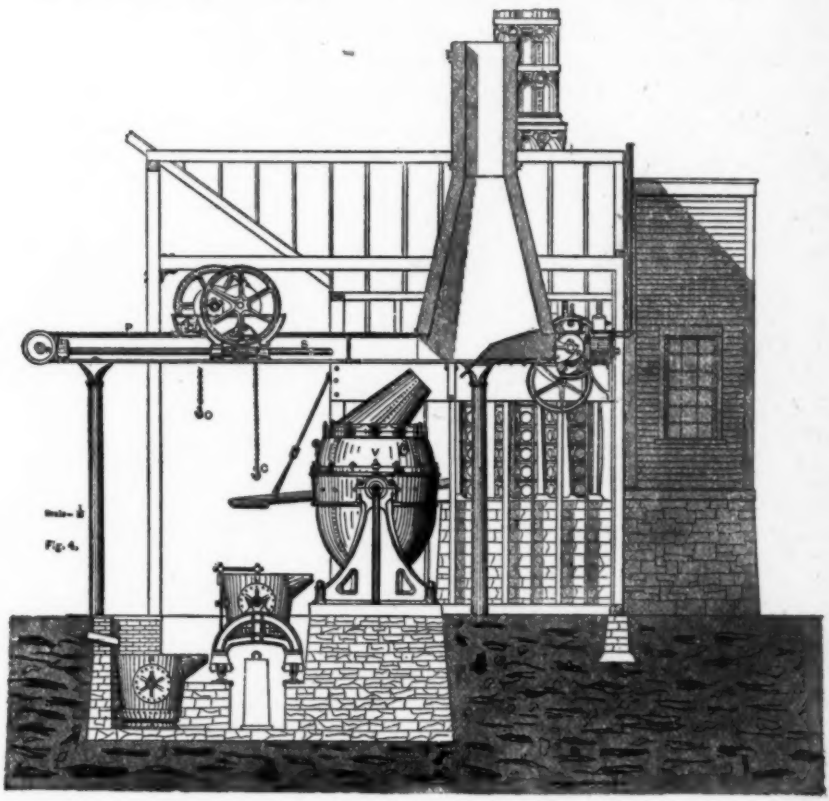

FIG. 61.—CROSS-SECTION OF THE CASTING-HOUSE AT WYANDOTTE.

very like converters that he had seen abroad." In the winter of 1862–'63 the blowing engine was commenced, but owing to various interruptions it was not completed till the spring of 1864.

The plan (Fig. 60) shows the general features of the arrangement adopted, save that over the casting-pit was a single-track traveling-hoist for handling ingots and molds. This hoist was operated by a winch located at *w*, the space allotted me in the casting-house not permitting the use of a crane of ordinary form.

The reverberatory furnace for melting pig iron was not included in my original programme; but in the summer of 1864, before the first conversion was made, it was decided to erect it in order that we could experiment with a variety of brands of pig

iron sent us by parties interested in the works. A hearth was made near the base of the chimney for melting *spiegel;* and subsequently a small furnace (located at S, Fig. 60) was constructed for melting *spiegel* when the metal for conversion was taken direct from the blast-furnace.*

Continuing our description of the works, Fig. 61 is a view of the machinery in the casting-house as it appeared to a person standing in the "pulpit" (see Fig. 60) and looking toward the converter, V. This converter is represented on a larger scale in sectional ele-

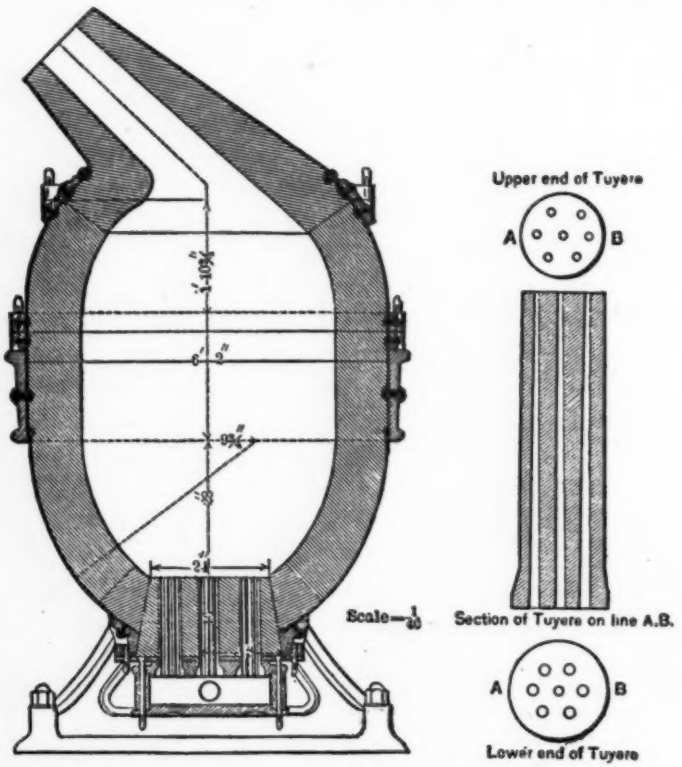

FIG. 62.—SECTION OF THE FIRST AMERICAN STEEL CONVERTER.

vation by Fig. 62; and to the right of this figure is seen a longitudinal section and end views of one of the seven *tuyères* used in the converter. This vessel was made with its upper part in two separate sections, and it was supported on its trunnions by two

* It was at these works, in the summer of 1865, that Z. S. Durfee made the first attempt to melt pig metal in a cupola for use in the converting vessel. At that time the practice abroad was to melt the metal in a reverberatory furnace. Owing to the small size of the cupola and its distance from the converting vessel, the experiment was not entirely successful; but Mr. Durfee did not abandon his belief in the usefulness of this process. I claim for him the origination of the idea of cupola melting, which has contributed so much to the rapidity and economy of production in the steel-works of the world.

tall cast-iron standards, and was turned by worm-gearing arranged to be driven either by hand or power. The engine which supplied the blast to the converter is represented in front elevation by Fig. 63; it was constructed from original working drawings made by the writer. It was intended to produce a pressure of blast of sixteen pounds per square inch, which was regarded as very heavy; in fact, I was informed, at the time of commencing the plans for this engine (the winter of 1862–'63), that the pressure used for blowing steel in England and Sweden was but eight pounds. I adopted the higher pressure with a view to shortening the time required for a "blow," but I soon became satisfied that this was a mistaken departure. I found myself in most excellent company, however, for, before my engine was finished, steel was blown in England with a blast pressure of twenty-five pounds, a practice which has continued until the present time. The engine had three upright cylinders of the same internal dimensions (twenty-four inches in diameter and thirty-six-inch stroke), the middle one being the steam cylinder and the outside ones the blowing cylinders.

Very soon after entering upon the study of the new process it became evident to me that an accurate knowledge of the chemical constituents of the metals and other materials employed was essential to its successful conduct; for, after we had found by working them that certain irons were, and others were not, suited to our purpose, analysis would in future enable us to determine whether any offered brand of iron was of suitable quality. These considerations, with others, determined the addition of a chemical laboratory to the works.*

As late as 1868 a large establishment for the manufacture of steel (in which over a million dollars was invested) commenced operations in western Pennsylvania, and at the end of one year it was abandoned and dismantled, the whole of the investment having been utterly lost in consequence of attempting to use material which an analysis costing not over fifty dollars would have shown to be absolutely unfit for the purpose intended. American "iron-masters" (so called) were not alone in their contempt for chemistry. I have in my possession a pamphlet published by a well-known firm of steel manufacturers in Sheffield, England, as late as 1870, for the purpose of attracting attention and trade, in which the following sentences occur: "The various articles on the

* At this time there was no such thing as a laboratory in connection with a steel-works in America: to the so-called "practical steel-makers" chemistry was an unknown and unappreciated science, and no sneer was too cynical for them to bestow upon those who advocated its employment. The laboratory at Wyandotte (which was derisively called "Durfee's 'pothecary-shop") was ultimately destroyed by the influence of incarnate malicious ignorance.

manufacture of cast steel in encyclopædias and other works are for the most part out of date or are written by scientific men having little or no practical acquaintance with the subject, and consequently are not of much value. . . . The steel manufacturers of Sheffield are not chemists. The application of chemistry to the manufacture of cast steel has not yet met with any success. The

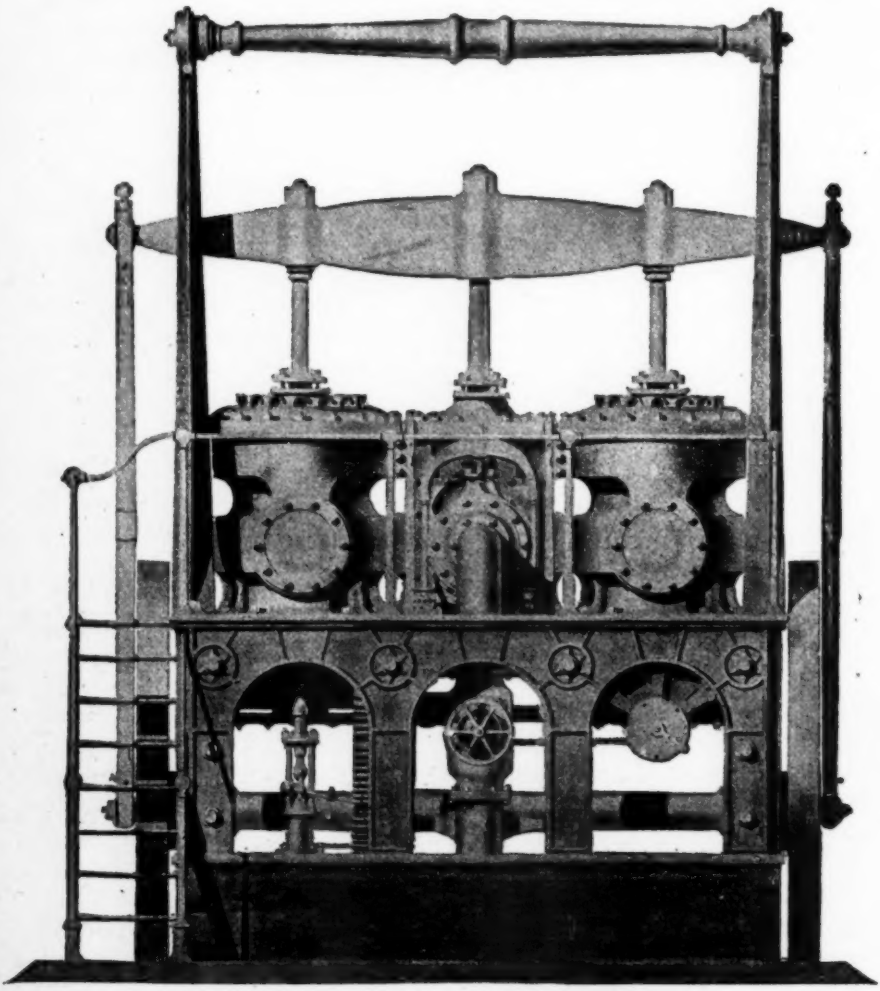

FIG. 63.—BLOWING-ENGINE OF THE WYANDOTTE WORKS.

analysis of steel is a very difficult process. It has frequently been attempted in Sheffield, but never with any practical success." It is possible that the triumphs of chemistry during the past twenty years, as illustrated by the Thomas-Gilchrist and many other important improvements in metallurgical practice, may have convinced the worshipers of the ultra-practical—American

as well as English—that there are possibilities in chemistry not dreamed of in their philosophy.

The need of a laboratory was fully appreciated by Mr. Z. S. Durfee, and in the spring of 1863 he secured the services of Mr. Emil Schalk, a native of Germany, and a graduate of the École Centrale of Paris, as chemist. On his arrival in Detroit, at the request of Captain E. B. Ward, he accompanied an exploring party to northern Wisconsin. The result of this expedition was the discovery of a number of deposits of excellent iron ore.

On Mr. Schalk's return in October, 1863, he commenced some original investigations with a view to determine the influence of nitrogen upon steel, which promised to develop very interesting and valuable results; but, unfortunately, circumstances for which

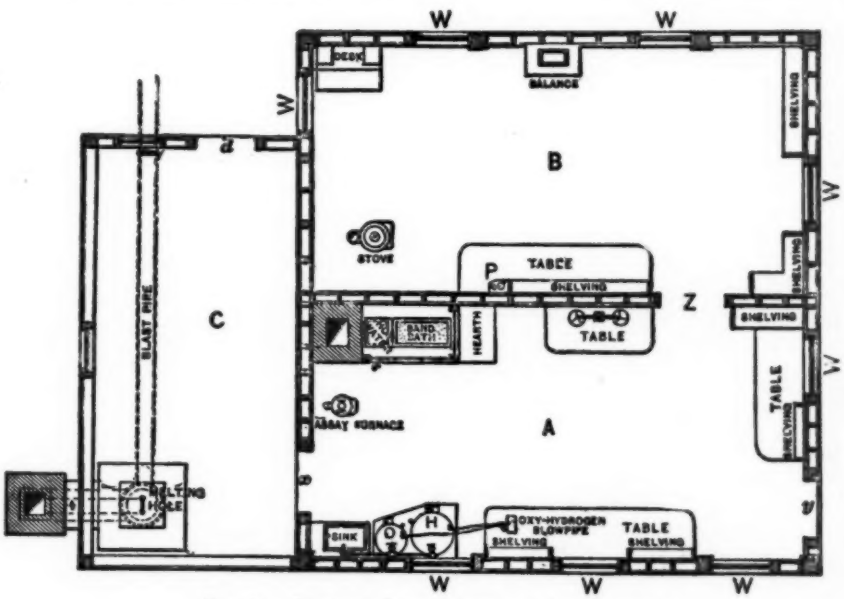

Fig. 64.—Chemical Laboratory at Wyandotte.

he was in no way responsible caused his resignation in December, 1863, before they were completed. Of Mr. Schalk's abilities I had the highest estimation, and I very much regretted his departure from Wyandotte.

I will now describe the arrangement of the laboratory. The main building shown in the plan (Fig. 64) was about twenty-four feet square; it was divided by a partition into two rooms, A and B, of equal size, and each about eighteen feet high. At the rear of this building was a lean-to shed, C; *d* is an entrance to this shed from without; *x*, a door communicating with A; and *y* is the main entrance to the building. The room A was used for general analytical work, and was provided with furniture and

apparatus, as shown in the plan. The furnishing of the room B is also indicated.

The "melting-hole," in the corner of the lean-to shed C, was large enough to receive a pot which would hold seventy pounds of melted metal. Space will not permit a detailed description of the apparatus used in this laboratory,* but it would be regarded at the present day even, as thoroughly adequate for its purpose.

In the works at Wyandotte, on one of the early days of September, 1864, was produced, under the supervision of the writer of these papers, the first "Bessemer steel" † made in America.

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* This description of the Experimental Steel Works of Wyandotte is, owing to space limitations, much curtailed; but any interested reader will find in the Transactions of the American Society of Mechanical Engineers, vol. vi, p. 40, and in the Transactions of the American Institute of Mining Engineers, vol. xii, p. 223, papers by the writer hereof in which much more attention is given to details than is here permissible.

† I adopt here and elsewhere in this article the popular designation, for the reason that I believe it to be the just and proper one; for, while there is no room for a doubt that the late William Kelly anticipated Bessemer by several years in the discovery of the fundamental idea of the process, he did not carry it out to its ultimate possibility as a means for the manufacture of steel; and while there is no reason to believe that Bessemer ever heard of what Kelly was doing, it is pretty certain that had not Kelly noted the granting of a patent to Bessemer he would never (owing to his unfavorable location supplemented by pecuniary embarrassment) have been able to procure such attention from the iron trade of this country as would have insured him any reward for his invention. Furthermore, although in Kelly's stationary "converter," it would have been, under proper management, quite possible to make a satisfactory quality of steel (stationary "converters" were used in Sweden with success for many years), it was quite evident from the first that the highly original and ingenious apparatus invented by Bessemer (especially the tilting "converter," and the "casting ladle" having a tap-hole in its bottom) was far superior to anything proposed by Kelly. It is also quite evident that had not Mushet (or some one else) suggested the use of *spiegeleisen*, neither the ideas of Kelly nor Bessemer would have been of value except in the direction in which they were practically carried out by Kelly as a substitute for the refinery-fire, or in the special case of iron containing a notable quantity of manganese (as was the fact in those used at first in Sweden); but it is not at all probable that Kelly would have discovered what was necessary to perfect the process, as he had no knowledge of *spiegeleisen* (in 1857 no iron was known in the commerce of America by that name) and was not a chemist or an employer of chemists—but, judging from the fact that Bessemer availed himself of the aid of chemistry at an early day in his investigations, it is not at all improbable that he would have himself discovered the value of *spiegeleisen* had not Mushet anticipated him. I think all the facts warrant the naming the discovery The Bessemer-Kelly-Mushet Process; but as Bessemer, by his ingenuity, persistence in methodical endeavor, and business sagacity, is clearly entitled to the first place, and if the process is to bear but one name, the popular verdict of over thirty years is fully justifiable in calling it "The Bessemer Process."

While we are thus considering the relative merits of the chief actors in this metallurgical drama, it is but just that we should award due praise to Martien, the American, and Parry, the Englishman, for ideas of great originality, which, had they been followed out to their logical conclusion, must have developed similar results to those attained by Bessemer. These metallurgists evidently were standing, as it were, on the "delectable mountains" of discovery, and seeing dimly and afar some suggestions of the practical glories of the metallurgy of coming generations.

This event was a great disappointment to all those who had filled the air with predictions of failure, and they immediately turned their attention to a general depreciation of the results attained, and the persecution, with renewed vigor, of all who were responsible for them.

The first steel rails produced in America were rolled at the works of the Chicago Rolling-Mill Company (now a part of the Illinois Steel Company's plant, but then under the superintendency of O. W. Potter, Esq., late President of the Illinois Steel Company), at Chicago, on the 24th day of May, 1865. These rails were successfully rolled in a "twenty-one-inch three-high train," whose rolls were intended for rolling iron rails, and this fact is indubitable evidence of the excellent quality of the steel. There were three rails rolled on the 24th, and on the 25th three others.* Various experiments were tried to test the ductility and working qualities of the steel produced at Wyandotte; some of the early product was sent to Bridgewater, Mass., and there rolled into tack plate and cut into tacks, which were pronounced to be very much superior to any previously made of iron.† In order to test the welding qualities of the steel, John Bishop, the blacksmith of the works, made a tobacco-pipe, the size of an ordinary clay pipe, the bowl and stem of which were welded up of Wyandotte steel, and when perfectly polished there was no visible evidence of a weld. I have now two jackknives and a razor made from this steel; the knives are rather soft, but the razor was used regularly by my father for fifteen years, to his entire satisfaction.

When it had been shown that the pneumatic process was a qualitative success, instead of carrying out the original understanding and erecting new works arranged with especial reference to rapid and economical working, the parties in interest insisted that I should put a second converter into the experimental works, and attempt to make it a commercial success. Knowing that such an attempt could only result in utter failure, I resigned my position (June 1, 1865). Nevertheless, the proposed plan was carried out, and the works were permanently closed after about a year's unprofitable experience.

While the experimental works were being constructed at Wyandotte, the firm of Winslow, Griswold & Holley was formed for the purpose of purchasing Bessemer's American patents, and manufacturing steel under them. Negotiations with Bessemer were concluded in the spring of 1864, and an experimental plant at Troy, N. Y., was started on February 16, 1865.

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* These rails were laid in the track of the Chicago and Northwestern Railroad, and it is known that they carried the traffic over ten years, but unfortunately there is no record of the time when they were taken out and discarded.

† It is believed that these were the first tacks made of steel.

The purchase of the American patents of Bessemer by this firm at once challenged the right of the Kelly Process Company to employ the process invented by Kelly, and to the use of the apparatus invented by Bessemer; but, at the same time, the Kelly Process Company having purchased the Mushet patent for the use of *spiegeleisen*, was in a position to challenge the possibility of Messrs. Winslow, Griswold & Holley's making steel by the "Bessemer process" at all. The validity of the Bessemer patents for apparatus was, from the first, conceded by the Kelly Process Company, and arrangements were made, as soon as it was ascertained that they could not purchase the American patents of Bessemer, to dispense with the use of the machinery protected thereby; for they could avail themselves of that used by Kelly, which, although not nearly as convenient, was still, with some obvious improvements, capable of doing good work; or, rather, what the practice of the time called such.*

In view of these facts the Kelly Process Company was clearly the master of both the legal and commercial situation; and had it been governed by an enlightened business selfishness it would have profited by the advantageous position in which (thanks to the indefatigable labors of the late Z. S. Durfee, its secretary) it was placed; but in order to do this the law had to be invoked, and to the majority of the members of the Kelly Process Company the law was a terror! Lawyers must be paid! Experts would not testify gratuitously! Costs of court would accumulate! Judges were doubtful! Jurors were uncertain! And then, if victorious, what would they gain? And if defeated, utter ruin would overwhelm them! Never before or since has a party of reputable business men been so needlessly alarmed and so utterly oblivious of the first principles of a sound business policy. The various bugaboos and hobgoblins which their terrified imagination conjured up of the horrors of the life to come among courts, judges, lawyers, experts, witnesses, and obstinate jurors, in case they ventured to assert in a court their manifest right, at last drove them into making a proposition to Messrs. Winslow, Griswold & Holley looking to a combination of the interests of the two companies, and to their final acceptance of an agreement under which they surrendered rights which were of great value to Messrs. Winslow, Griswold & Holley, and obtained practically no rights in return save that of receiving but thirty per cent of the royalties earned by the combination, and that of leaving to Messrs. Winslow, Griswold & Holley the remaining seventy per cent.

* In the early days of the Bessemer process, three "blows" in ten hours was thought to be a very creditable performance, but at the present time a works that could not make that number in an hour would be regarded as a fit subject for an inquest.

In the whole history of business affairs it would indeed be hard to find a more perfect illustration of "the tail waggling the dog" than this. It is only justice to the late Z. S. Durfee to say that he opposed this compromise and its unjust disposition of the rights of himself and associates with all the energy of which he was capable; and the fact that all the royalties the combination ever earned were received under the operation of an extension of the patent of William Kelly is quite sufficient to justify his business sagacity and foresight.

The experimental works erected by Messrs. Winslow, Griswold & Holley at Troy were used for nearly two years for the purpose for which they were designed, and their proprietors "extended every facility to blast-furnace owners in all parts of the country to have their irons tried for steel; . . . many were tried and most were found wanting."* It does not appear that any effort was made to compare the chemical composition of the irons that made good steel with that of the irons that would only make bad steel; and what was "good metal" seems to have been decided by actual treatment in the converter. Notwithstanding the numerous failures in the Troy works to make good steel out of poor iron (all tending to discredit the process), there were a sufficient number of successes and enough "good metal" discovered to encourage the firm in the erection of new works (called the five-ton plant) on a manufacturing scale. January 1, 1867, the late A. L. Holley left the Troy works to take charge of works at Harrisburg, for which he had furnished the plans.† For a short time after the departure of Mr. Holley the Troy works‡ were under the charge of Mr. John C. Thompson. He was succeeded by Z. S. Durfee, who "built the forge and made some alterations both in plant and details of manufacture. Among other things, he adopted for the small or experimental plant the practice of melting the recarburizing metal in crucibles, and obtained most excellent results. . . . Mr. Durfee resigned his connection with the works in 1868, and Mr. Holley once more became the manager."

Up to January, 1871, the ingots produced in these works were

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* Paper by R. W. Hunt, Trans. American Institute of Mining Engineers, vol. v, pp. 201–216.

† The phenomenal development of the "Bessemer process" in America during the fifteen years preceding the death of Mr. Holley in 1882 was largely due to his efforts. For a full account of the life and labors of the late Alexander L. Holley, C. E., LL. D., the reader is referred to a memorial volume published in 1884 by the American Institute of Mining Engineers, and to an able address delivered by James Dredge, Esq., Honorary Member of the American Society of Mechanical Engineers, in Chickering Hall, October 2, 1890, on the occasion of the unveiling of the Holley Memorial Statue, in Washington Park, New York.

‡ These works are still running, the company owning them now being known as the Troy Steel and Iron Company.

either hammered in the forge, or "bloomed" from nine-inch ingots, at the Rensselaer Rolling Mill in Troy, N. Y., or the Spuyten Duyvil Rail Mill at Spuyten Duyvil, N. Y., and then rolled into rails at these establishments, but on the above date Mr. Holley had a thirty-inch blooming mill ready to run. This mill was the joint invention of James Moore, William George, and A. L. Holley, and was built by James Moore, at his Bush Hill Iron Works, Philadelphia. The mill was provided with front and back lifting tables raised by hydraulic power. The tables carried loose rolls, on which the twelve-inch ingot (heavy enough to make two rail blooms) was placed and pushed into the rolls by men. Eight men were required to attend the mill. This mill proved to be a great advance over previous practice, but in the fall of 1872 improvements were added (invented by George Fritz, of Johnstown, Pa.) which reduced the force required at the mill to three men and a boy.

It is manifestly impossible in these pages to give in detail the history of the several Bessemer steel-works now in operation, and I have been thus particular in sketching at length the inception and development of the plants at Wyandotte, Mich., and Troy, N. Y., because they were the genesis of the Bessemer steel industry in America, and their history admirably illustrates the manifold obstacles which the promoters of all ultra-novel and radically revolutionary inventions have always had to encounter. I well remember the sneers which greeted my statement that the time would come "when a steel rail could be made cheaper than an iron one"; and now that time having arrived, it is no small compensating satisfaction to know that the faith delivered thirty years ago to the workers at Wyandotte and Troy has expanded with the years and by "*works*" has been made perfect: mountains have been removed,* and the metal of their ores now in our railways binds the nation together with bars of steel, along which glide shuttle-like, to and fro, the steam-propelled carriers of the commerce of a continent; interweaving it with the warp threads of agriculture and all arts, and producing a fabric of national prosperity and happiness that shall wear through the ages and continue to clothe this people while time endures.

A modern establishment for the manufacture of steel rails is vastly different from those ancient "plants" in which bar iron and iron rails were made forty years ago. Works that would turn out seventy tons per day then were thought to be remarkable both in size and in administration, but at the present time there

* The "Iron Mountain" of Missouri, which at one time was supposed to be inexhaustible, has had all its ore passed through the "furnace" and converted into iron and steel; and it is only a question of a few years when other great deposits now regarded as "mountains of ore" will share the same fate.

are many mills in the United States that can produce more than ten times as much in the same time. In the more perfectly ar-

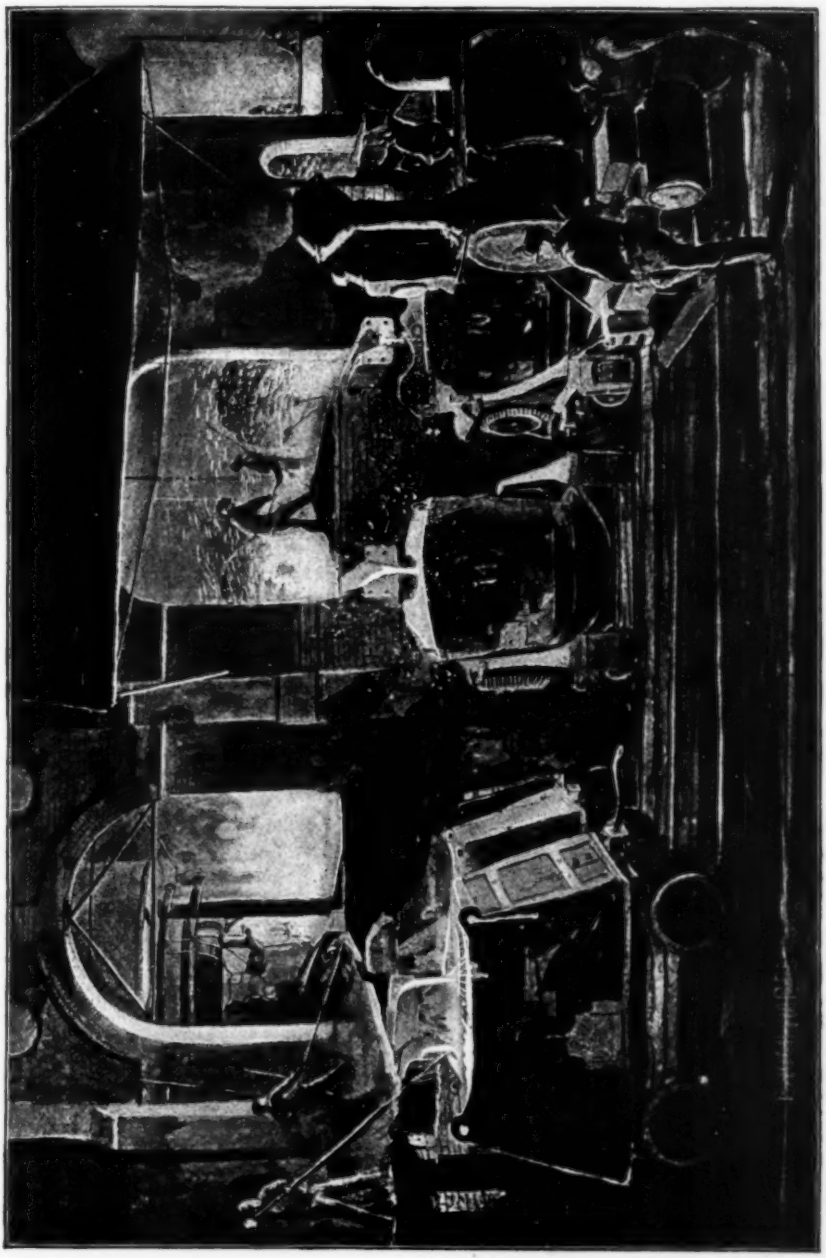

FIG. 65.—NIGHT SCENE OUTSIDE A CASTING-HOUSE.

ranged steel-works the molten metal is taken directly from the blast-furnace to the converter, and, after being "blown," is cast

into an ingot sufficiently heavy to make four rails; this ingot is taken from its mold while it is red-hot on its outside and still liquid internally, and put into a "soaking pit"* or a reheating furnace to prevent loss of heat, and as soon as possible, it is sent to the "blooming train" and rolled into a bloom; this is at once automatically conveyed to the "rail-train" and rolled into a continuous rail about one hundred and twenty-three feet in length, which is carried on rollers driven by power to the "cutting-off saws," which divide it into four rails of thirty feet in length, and the two extreme ends of the original rail, called "crop ends," are about eighteen inches long. The four rails, while still red-hot, are carried by machinery to the "cambering machine," and thence to the "hot-bed."† They are next taken to the "cold straightening presses," and any crookedness is removed by powerful pressure; the bolt-holes for "fish-plates" are then drilled in their ends, after which the rails are turned over to the "inspectors" representing the railway for which the rails are intended.

Fig. 65‡ is a very spirited night view of a scene outside the casting-house of one of the furnaces of the Illinois Steel Company. A portion of the furnace itself and one of its supporting columns are seen through the left-hand arch. In the left foreground are two "slag-buggies" being filled with liquid slag; on the right is a locomotive ready to pull them to the dump. In the center of the picture are two large "ladles" (numbered 14 and 10) capable of holding ten tons each of fluid metal, which is conveyed to them by the "runners" or "gutters" whose ends are seen projecting over the "ladles"; these gutters receive the molten metal direct from the "blast-furnace," and as soon as the "ladles" are filled they are drawn away by a locomotive which takes them up an inclined plane on to an iron bridge or platform, which extends across the converter-house in front of the converters. This bridge is plainly shown in Fig. 66, and a small locomotive is seen on the left-hand end of it.

Beyond this bridge, and between it and the back wall of the building, are the three converters, each intended for the conversion of ten tons of iron into steel at one operation. The left-hand

* This is a pit but little wider than the ingot, lined with fire-brick. The lining prevents the heat of the steel from radiating into space, and hence the internal heat of the ingot is diffused uniformly through its mass; and after being in the "pit" a certain time the ingot is apparently hotter than when it was put in; it is then taken out and rolled immediately. "The soaking-pit process," invented by John Gjers, is the most important improvement in the manufacture of steel that has been brought forward in the last eight years.

† This term is the reverse of descriptive. The "hot-bed" is a huge gridiron, on which the rails are placed to cool.

‡ I am under obligations to E. C. Potter, Esq., late Vice-President of the Illinois Steel Company for the very effective views from which this and the three following engravings have been reduced.

converter is shown "turned down," pouring its contents of liquid steel into a casting-ladle; the central converter is upright, and a

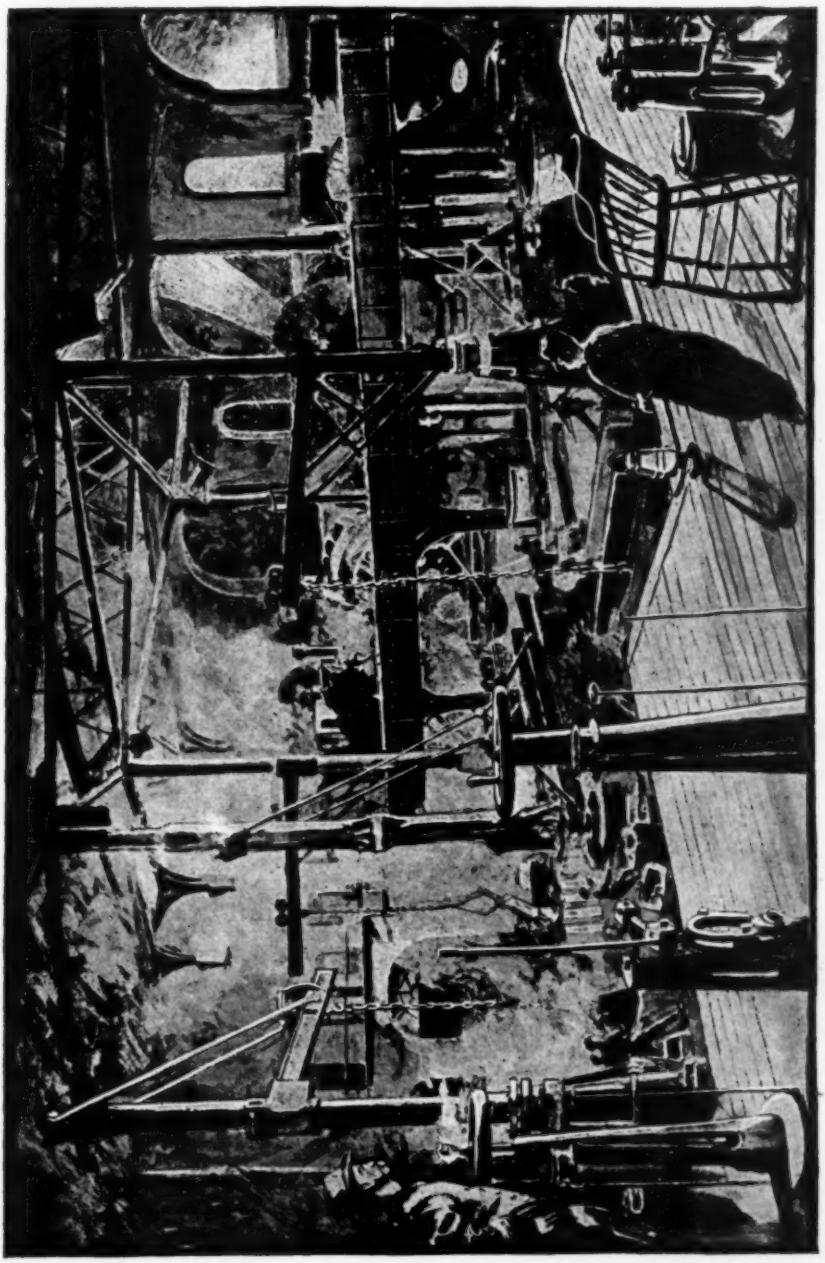

FIG. 66.—INTERIOR OF A CONVERTING-HOUSE BY NIGHT.

dazzling white volcanic flame issues roaring from its mouth, discharging itself though the open archway in the wall of the build-

ing—a "blow" is evidently under full headway. The third converter is seen on the extreme right of the picture, with its mouth downward, its bottom having been removed for repairs.

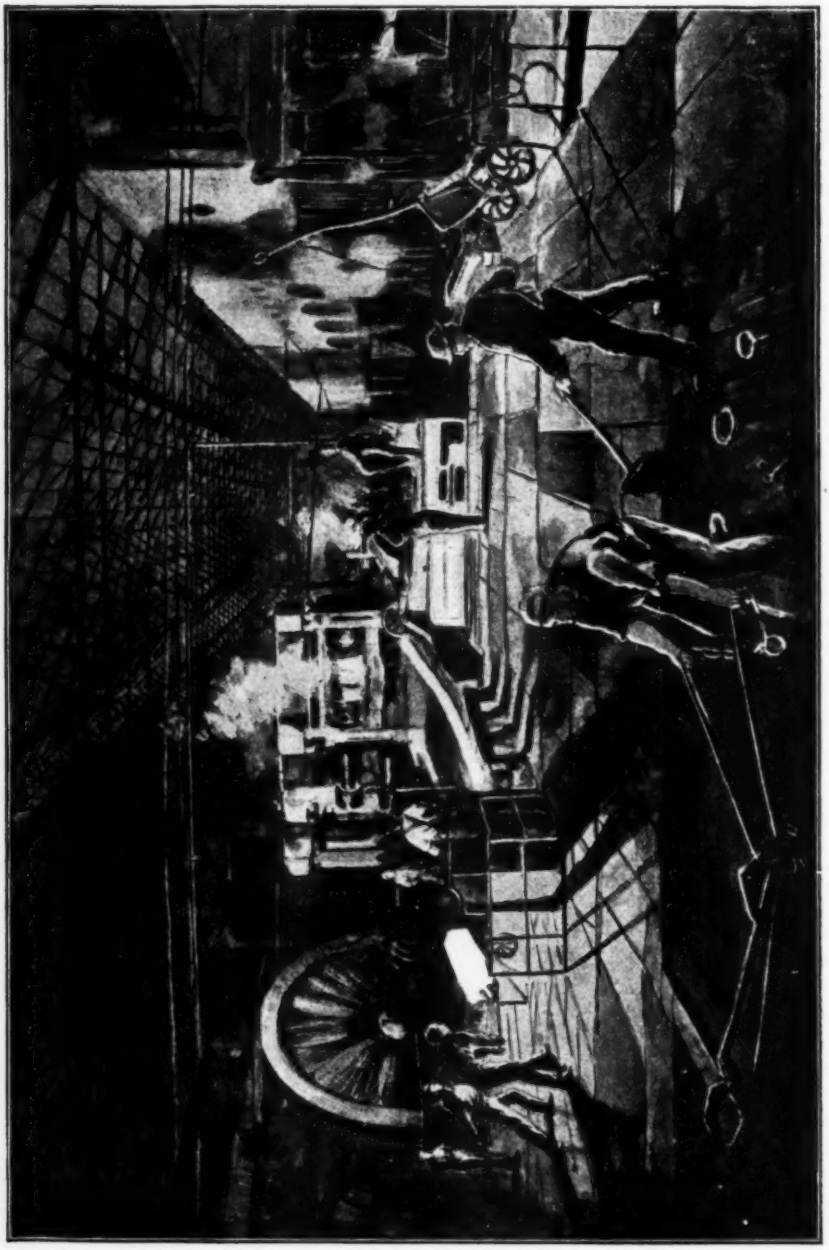

FIG. 67.—A STEEL BLOOMING-MILL.

In front of this bridge are a number of cranes, all operated hydraulically, but, unlike the ordinary "hydraulic press," whose

movement is usually very slow, these cranes are very rapid in their action, more so than any other form of crane; were this not the fact, it would be impossible to handle the vast quantity of hot materials—"ingots," and their "molds"—that must be disposed of with great promptness in a modern steel-works. These cranes are veritable giant arms, lifting and conveying with a tireless strength, insensible alike to heat and weight, such masses of steel as have only come to the knowledge of man since the invention of the Bessemer process.

The various operations of the "converting-house," embracing the turning of the converter, the regulation of the blast, and the movement of the cranes, are all directed and controlled by means of proper "hand-gear" located upon the platform called "the pulpit" represented in the foreground of the picture.

The general aspect of the interior of a converting-house at night is at once startling and grandly impressive. Here heat, flame, and liquid metal are ever present; locomotives whistle and puff, dragging with clatter and clang huge ladles of molten iron; the lurid light, flashing and flaming, that illuminates the scene, throws shadows so intensely black that they suggest the "black fire" of Milton, for in such a place it is impossible for a shadow to be cool; half-naked, muscular men, begrimed with sweat and dust, flit about; clouds of steam arise from attempts to cool in some degree the roasting earth of the floor; converters roar, vibrate, and vomit flames mingled with splashes of metal from their white-hot throats; at intervals the scorching air is filled with a rain of coruscating burning iron; ingot molds lift mouths parched with a thirst that can only be appeased for a short time by streams of liquid steel that run gurgling into them; the stalwart cranes rise, swing, and fall, loading scores of tons of red-hot steel upon cars of iron: all these conditions and circumstances combine to make an igneous total more suggestive of the realms of Pluto than any other in the whole range of the metallurgic arts.

The ingots of steel are taken from the "converting-house" as promptly as possible after they are cast, and carried on iron cars to the "blooming-mill" (Fig. 67), where they are put into gas-fired furnaces (the end of one is seen on the right of Fig. 67), where their heat is maintained, and thence they are taken to the "blooming train" and rolled into blooms. The steel-rail bloom is a rectangular bar of steel, long enough to produce four or even six rails.

In the cut (Fig. 67) on the left is seen a white-hot ingot of steel being carried on an iron "buggy" to the rolls of the blooming train, which occupies nearly the center of the picture. On the right of this train is seen a bloom about to pass through the

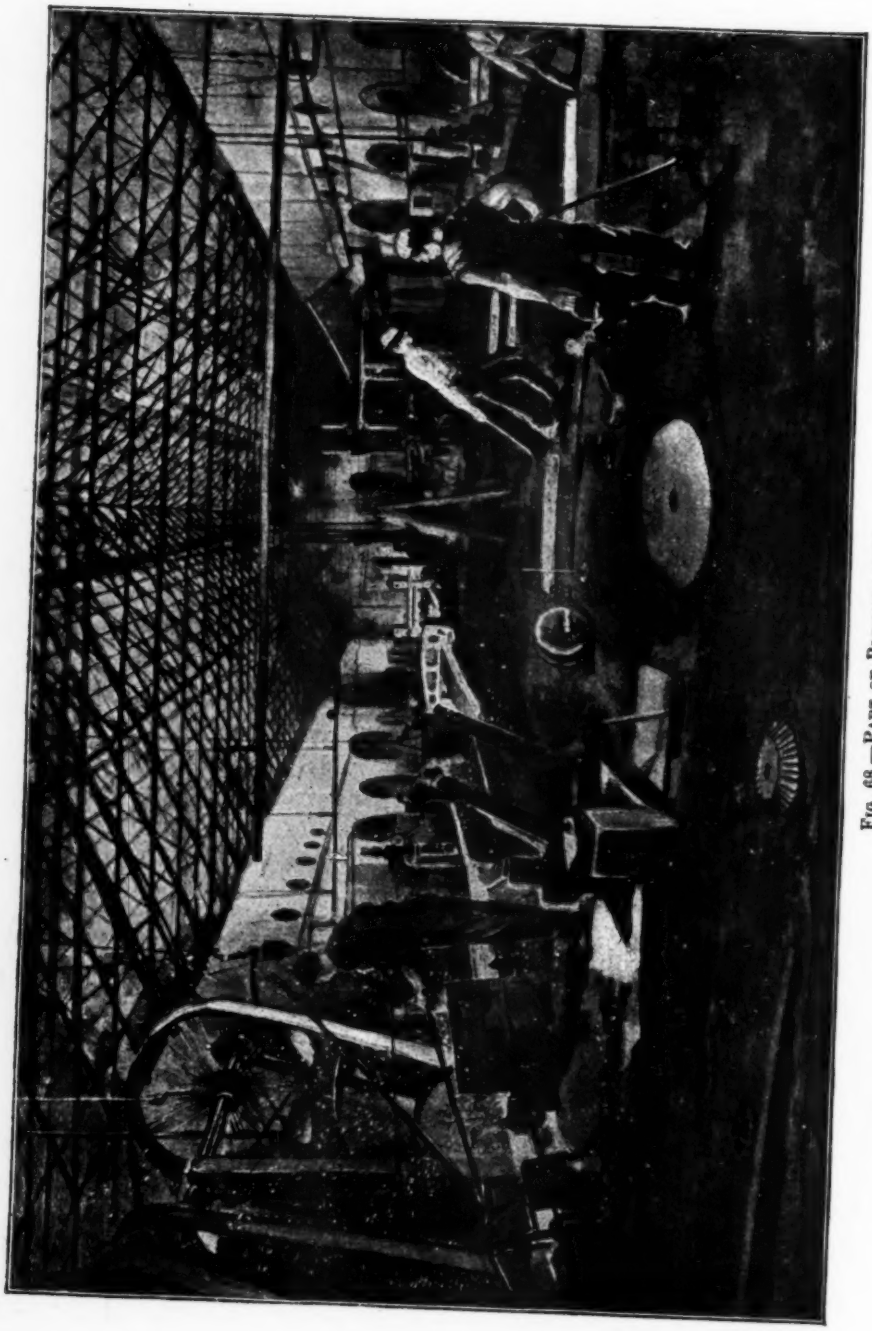

FIG. 68.—PART OF BLOOMING-MILL.

"finishing groove." The blooming train has a heavy fly-wheel driven by an engine of great power. In the farther part of the building is seen a cloud of steam which marks the location of the "rail train," to which the finished bloom is conveyed by mechanical means. Fig. 68 is a very spirited view of that portion of the rail-mill beyond the rail train (which is seen in the distance on the left of the picture). In the left foreground is shown one of the saws which cut the rails into lengths, and near the center of the picture a man is seen dragging out one of the "crop ends."

In all these views the small number of men employed in proportion to the work performed is very noticeable. By comparing one of these cuts with Fig. 47, the great difference between the practice of the present and that of thirty-six years ago in this respect is very evident. In 1855 a very large proportion of the work of a rolling-mill was performed by the strong right hands of a multitude of workmen; but in our day much more and heavier work is accomplished by powerful machinery—the crystallization of ideas emanating from the strong right head of some mechanical engineer, who had the ingenious courage to devise hands of iron, and muscles of steel, to do the required work of the present.

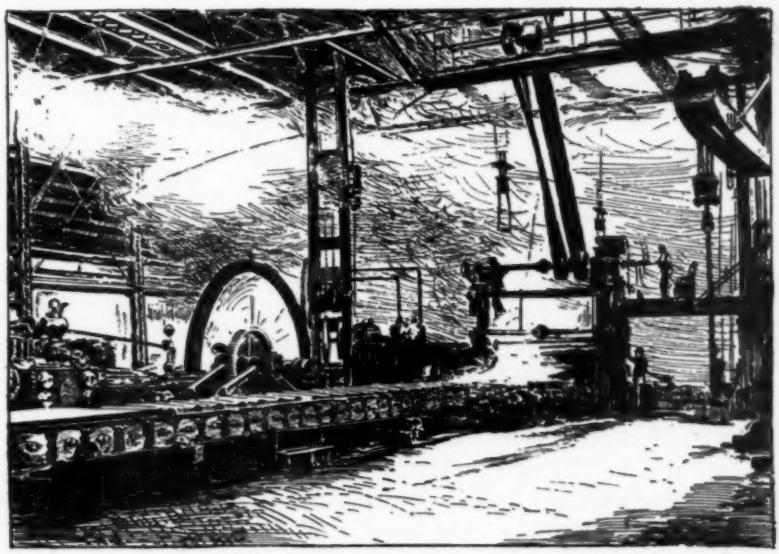

FIG. 69.—VIEW OF PLATE-MILL.

Fig. 69 is a view of a plate-mill at the Homestead Steel Works (Carnegie, Phipps & Co.) near Pittsburgh, Pa. This mill is what is known as a "three-high plate-mill." The train of rolls is driven at the rate of fifty revolutions a minute. On the delivery side of these rolls is a roller table five feet in width and 363 feet long, the rollers being driven by power. This mill can roll plates

three inches thick and 115 inches wide, or sheets $\frac{3}{32}$ of an inch thick and 117 inches wide, and of course any intermediate dimensions of any length, and of a weight not exceeding six tons. This mill can turn out five thousand net tons per month.

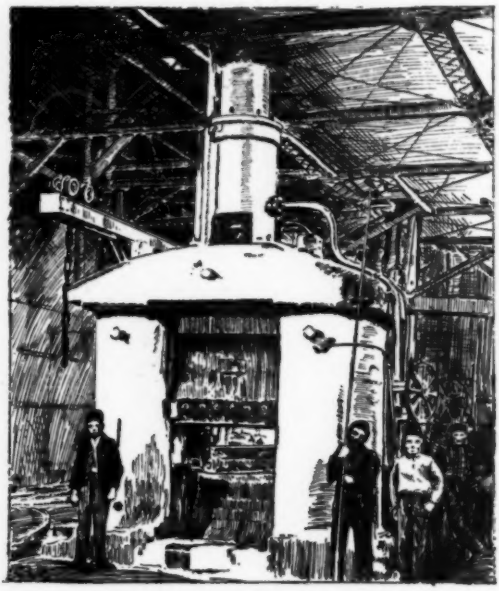

FIG. 70.—HYDRAULIC SHEARS.

Fig. 70 * is a view of the hydraulic shears in the "slabbing-mill" of the Homestead Steel Works.

The men in the picture will assist the mind of the reader in forming a correct idea of the magnitude of this ponderous piece of mechanism, whose purpose is to cut into the required lengths the "slabs" as they come from the "slabbing rolls." The lower knife is stationary, and the movement of the upper knife in a vertical plane is insured by guides on the "housings" of the machine. The upper knife is actuated by a water pressure of about three thousand tons, and the shears are capable of cutting a section $24'' \times 48''$ of hot metal. The "slabs" are taken to the plate-mill, reheated, and rolled to the required dimensions. The above description of some of the machinery in use in the Illinois Steel Works and in the Homestead Steel Works must serve for illustrating the ponderous character of the mechanism of a modern "steel plant," as it is plainly impossible in this paper to speak of details which would require a volume to adequately explain.

The "Bessemer process," as for many years conducted, could only deal successfully with iron which contained a very small quantity of phosphorus; this being the case, a very large proportion of the world's make of that metal was useless for the manufacture of steel; and therefore it was evident that any improvement by which such iron could be made available would have great value. This fact stimulated inventors to endeavor to dis-

* Figs. 69 and 70 are reduced from photogravure engravings illustrating a paper by W. Richards and J. A. Potter, descriptive of the Homestead Steel Works, which was published in vol. xv, No. 3, of the Proceedings of the United States Naval Institute.

cover some means by which pig iron high in phosphorus could be used in the "converter" or "open-hearth" furnace. Success was finally achieved in this by two English chemists, Sidney Gilchrist Thomas and Percy C. Gilchrist, of London, who secured patents for their invention November 22, 1877.* Their modification of the "Bessemer process" consists in the employment of *lime* as the chief constituent of the lining of the "converter" or "open-hearth furnace," and the action of this "basic lining" (hence the process is commonly called the "basic process") is to remove the phosphorus from the metal as a "phosphate of lime," in which condition it is found in the "slag" produced. There are a number of claimants, English, French, and American, for the discovery of the value of lime as a lining in "Bessemer converters," and "open-hearth furnaces" for the treatment of iron rich in phosphorus, who have caused so much litigation as to retard greatly the use of the "basic process" in this country; but, nevertheless, there were made during the year 1890 about ninety thousand tons of "basic steel" in the United States. The "basic process" is very largely employed in Europe, and fairly deserves recognition as the most important improvement in the metallurgy of steel that has been practically developed within the past dozen years.

In recent years there have been a number of alleged improvements in the manufacture of steel patented, most of them having no value.

It will be remembered that some of the early American experimenters, who "with great pains and cost found out and obtained a curious art by which to convert, change, or transmute common iron into steel" (in Connecticut, 1728 to 1750), succeeded in making "somewhat more than half a ton of steel" in four years. This seed of the steel industry on this continent has year by year and generation after generation increased and multiplied until for the year 1890 the production of steel of all kinds in the United States reached the enormous total of "4,277,071 gross tons," an amount larger than was produced in that year by any other country in the world.

Twenty-six years ago there were but two Bessemer converters in the United States, and it is not at all probable that in the year 1865 there were more than five hundred tons of "Bessemer steel" made therein; but this germ product has so wonderfully developed that in the year 1890 the total production of "Bessemer steel" in this country was 4,131,535 net tons, or 8,263 times the

* It is but just to explain that the "basic process" as conducted in Europe involves the use of the invention of Messrs. Thomas and Gilchrist, in connection with those of G. J. Snelus, of Workington, and Edward Riley, of London, whose inventions have contributed materially to its success.

tonnage of 1865. This enormous output was made in eighty-five "converters" owned by forty steel-works, which were distributed in eight States, viz., Massachusetts, New York, Pennsylvania, West Virginia, Ohio, Illinois, Michigan, and Colorado.

In 1772 the American manufacturers' price for steel was equal to $186.66 per gross ton. Steel of better quality can be purchased of the American manufacturer of to-day for thirty dollars per gross ton, a decline of eighty-four per cent in one hundred and nineteen years.

Twenty-seven years have elapsed since the first Bessemer steel was made in America, and that time, improved by the labors of skillful men from among our engineers, metallurgists, and chemists, has wrought wondrous changes in the construction and management of our furnaces, steel-works, and rolling-mills. To-day the tendency of all metallurgical manufacturing enterprises is toward concentration, not only in commercial and administrative affairs, but in their machinery as well. Giant engines, ponderous roll-trains, colossal hammers, crushing forging-presses, stalwart cranes, furnaces whose "fervent heat" destroys all doubt of the possibility of the fusion of worlds, ore piles rivaling mountains in magnitude; enormous stores of coal, suggesting yet more enormous mines; a vast entanglement of railways to all parts of the works; a water-supply sufficient for a town; miles of subterranean pipes bringing gaseous fuel to the roaring mills—are but the common details of a modern establishment for the manufacture of steel. Practices once condemned as criminal extravagances are now regarded as essential economies; things once deemed impossible by men of little faith are but the familiar occurrences of to-day. Buildings, machinery, methods, have all been touched by the spirit of progress. Science has become better acquainted with art, and art has a better appreciation of science, and their united forces are marching forever forward. Before their steady advance difficulties vanish, obstacles are surmounted, and seeming impossibilities are overcome; sound principles are established in place of empiricisms, and educated skill replaces laborious ignorance. Verily, "old things are passing away and all things are become new."

EVIDENCE is given in the Rev. Thomas Parkinson's Yorkshire Legends and Traditions of the survival of the belief in fairies to a late date. An old man told the author a few years ago that his father, when young, had seen a dance of fairies, and that they were "of nearly all colors." A similar statement has been made to Mr. Parkinson's reviewer in the Athenæum, who suggests that such visions may be misinterpreted facts, not mere mental illusions. The birds called ruffs dance in the moonlight much after the fashion of the round dances of yore, and some of these dances may have been mistaken for those of fairies.

DO WE TEACH GEOLOGY?

By ROBERT T. HILL.

THE late Prof. Alexander Winchell, who did so much to popularize geology in this country, asked, "Shall we teach geology?" and our educational institutions have answered the question in the affirmative by expending liberal sums for the endowment of chairs in schools and colleges. The question now is, not shall we teach, but do we teach geology?

No modern science has been so vaguely understood and so indefinitely represented as that of geology. Our text-books, as a rule, are from fifteen to twenty years behind in the presentation of the vast results of the army of investigators in the field; and even among the working geologists there are wide differences in regard to fundamental definitions and theories. This great study, which has done so much for the advancement of knowledge and for industry, is still in a chaotic condition; and even its elementary definitions, as given in our text-books, are conflicting.

In the popular mind, in consequence of the mighty throes into which geological interpretation precipitated religious thought, the science is usually considered an irreligious inquiry into the history of the earth, or a useless study of curious fossils and pretty minerals To the practical investigator and student, however, geology has but one meaning, and that is, the science which treats of the structure of the earth and its changes.

A glance at the curricula of our universities will show that few of them teach the subject on this basis; they deal with the science either in the old-fashioned historical way, or devote their energies to some narrow branch—for example, paleontology, microscopic petrography, or economic mineralogy.

Geology can in many ways be compared with architecture, inasmuch as it is a scientific art, requiring a knowledge of many special arts and sciences. The architect must have a knowledge of mensuration, carpentry, masonry, materials, chemistry, physics, decoration, and other specialties pertaining to house-building. Likewise the geologist or student of earth-structure must have a knowledge of chemistry, physics, biology, mineralogy, mensuration, and all the sciences which are useful in interpreting this structure. Although we would never mistake a house-painter for an architect, we are overwhelmed by paleontologists, microscopists, and theologians who assume the title of geologists, and teach their narrow specialties under the broader name. An ethnologist who studies primitive dwellings is not an architect, yet how many astronomical data concerning pre-nebular hypotheses

and pre-geological speculations are taught as geology, as if to mystify the minds of students!

I well remember a young man who went from one of our great universities a few years ago with particular mention upon his diploma that he had attained special excellence in geology; in later years he found himself face to face with some of the greater problems of earth-structure, and slowly it dawned upon him that he had no conception of what the study really was. He knew the names of many fossils and minerals, could enumerate the historical sequence of the geologic time-epochs, but when required to report upon a new and strange region he found himself ignorant of the four necessary geologic rudiments—determination, definition, distribution, and delineation.

There is hardly a college in the land in which the study of the structure of the earth is not made subservient to the study of its history and composition, and in which the student does not learn to consider the extraordinary instead of the ordinary, by being taught to begin away back in Archæan time, and thence to trace the history of life-epochs. But the working geologist regards time-nomenclature as a secondary consideration, and the word Archæan means to him only a common dumping-ground for all older terrenes whose structure has not been differentiated.

Geology is not a science of the past, but a grand study of the present structure of the earth, its contour, composition, and readjustments. Geology has nothing to do with the origin or beginning of the globe—a field of inquiry purely astronomical—but takes the earth where astronomy leaves it, a completed mass of matter, and investigates its changes. Although Hutton a hundred years ago presented this thought in his saying that in the economy of Nature there is no trace of a beginning or evidence of an ending, still much of our geologic instruction is wasted on these subjects.

The cultural aspects of civilization are due to geologic structure, but in how many of our institutions are students taught to appreciate the topography or configuration of the earth's surface and its relation to structure, or to observe with inquiring eye the forms and contours of the landscape? The student usually learns the chemistry of certain nicely arranged hand specimens of hard rocks, and memorizes the names of leading fossils or the crystallography of minerals under the guise of economic geology. As a result, the study is supposed to be merely the study of hard rocks and curious fossils. Although the student knows these by sight, he can not trace a rock-sheet above the ground or below it, or see the great soft terrenes void of fossils and rocks which make up the larger area of our country, and can not appreciate the broader relations of structure to agriculture, hygiene, climate, and civili-

zation. Hence the great unfossiliferous terrenes are unknown; for example, the non-mountainous regions of the West and South, over which in places one may travel from the Rocky Mountains to the Gulf of Mexico without finding a fossil, a crystal, or a building-stone.

There is but one geological laboratory, and that is the great out-of-doors; and no student should learn a fossil or a mineral until he has first studied the landscape and is able to distinguish one stratum with its topographic form from another as strata, and not as fossil beds or chemical compounds. A field-glass and a quiet seat upon a commanding eminence, where the local surroundings can be studied, are worth to the beginner miles of traveling about with hammer and specimen-bag; and a thorough curiosity aroused as to why one hill is flat, another round, or one stream broad and sluggish while another is narrow and rapid, is more valuable than a cabinet of curios. An inquiry as to the origin of sediment in a river, whence it came, and what will become of it, will lead to a grander conception of earth-stripping and formation-making than the memorizing of all the specimens in a laboratory.

It is not my wish to discourage the study of paleontology or petrography, but is it not a serious error to teach these first and geology later? They are to geology as trigonometry is to mathematics, something that follows the fundamental arithmetic and algebra.

Some one has said that geology begins and ends with the raindrop. If not literally true, the saying is worthy of consideration; and if the teacher begins with it, his students will soon be familiar with the grand facts of the erosion and distribution of earth-matter, and the origin of the rock-sheets that make the whole, and the life-history of our earth's great cycles can be read.

When we lay by our icthyosaurians and useless crystals for advanced study, and teach the ordinary and not the extraordinary features of the earth, geology will be appreciated, and every farmer, every builder of homes, every drinker of water, will learn that upon a knowledge of its simple laws his success depends.

To the high-school student a knowledge of the structure of the earth is as important as chemistry or foreign languages; but, until some simple text-book is written dealing with the subject on these lines, it is not to be expected that geology will be generally taught.

THE principal achievement recorded in Dr. Hugo Zöller's recent explorations in New Guinea consists in the ascent of the Finisterre Mountains to a height of 8,700 feet, and the discovery of a still loftier range inland, which appeared to be covered with snow. Comparative vocabularies are given of forty-four languages, most of which were collected by the author himself or under his supervision.

DRESS AND ADORNMENT.

III. ORNAMENT.

By Prof. FREDERICK STARR.

THE savage loves finery. Anything bright and showy has for him remarkable attractiveness. Traders have often been blamed for their unequal trades with unsophisticated savages whereby they get a large return for articles of little value. Yet it must be admitted that often they could do little else. Truly useful and desirable articles are often passed by, and tawdry ornaments, beads, and tinsel are sought with avidity. The writer himself has frequently found, if cash payment is offered, that Indians demand preposterous prices for objects of ethnological interest; a few handfuls of beads or some yards of bright ribbon will bring about a quick and mutually satisfactory bargain. Early travelers found no people on some of the islands of the Pacific who would give anything for new kinds of fowls, domestic animals, or useful devices, but "a few red feathers would buy the whole island." "Necessity is always secondary to luxury" is a remark that will bear frequent quotation. Ornament is universal. The barbarian will go naked, unprotected, hungry, but he will have his ornaments.

Fig. 1.—American Indian with Necklace of Claws.

The beginnings of ornament lie far back in antiquity, but they may also be seen in savage life of to-day. The incentive that develops it is personal vanity—the desire for self-individualization. A man wishes to mark himself off from his neighbor by some external sign. If he kills a savage beast, what is more natural than that he should use its skin, its teeth, its claws, as a trophy? Wearing these, he is known as a mighty or successful hunter. Possibly the oldest decoration we know is a necklace from Duruthy Cavern, in France. Under a stone, apparently

fallen from the roof, was found part of the skeleton of a man. He had been crushed probably by the descending mass. Scattered about in such a way as to show that they had been strung together, were some forty large canine teeth of the cave bear, an animal now extinct. The teeth were perforated, and several were carved — not poorly — with animal and other designs. This necklace must have been originally a fine affair, and it is a good example of trophy-wearing. Naturally, what happens in hunting life may also occur in war. There, too, parts of enemies slain in battle may be worn as trophies. In the Louisade Archipelago, bracelets made of the jawbone and clavicle of foes killed in war were worn by warriors. Nearly all North American tribes formerly took scalps, which were worked up as fringes for garments, head-dresses, or other articles of ornamental dress. Trophies of the chase or of war were, we firmly believe, the first objects of decoration, and their only purpose was to render conspicuous the individuality of their wearer. Later the *idea of beauty in ornament* arose, and with it a host of objects which were *not* trophies came to be worn.

FIG. 2.—ORNAMENTAL APRON MADE OF TOUCAN-BONES. Mundurucu Indians, South America.

In examining the objects of ornament worn by savage, barbarous, and civilized tribes, we find a marvelous variety of materials and designs. We are amazed at the ingenuity displayed in making the most unpromising materials into things of beauty. Through this impulse of personal vanity—the wish to emphasize his individuality—man has been led to make many interesting discoveries and to develop many important arts. A dude is not a pleasant object; but, after all, the motive which has produced him has been of vast service in the world's progress. We will consider some instructive examples of ornament. The animal,

vegetable, and mineral kingdoms have all been laid under tribute for materials. Teeth, claws, shells, pearls, bone, hair, ivory, feathers, beans, seeds, grasses, leaves, fibers of all kinds, crystals, metals —these are but a few of the many substances that man has learned to use, more or less effectively, in self-adornment.

Necklaces are universal. Very simple are the garlands of red and yellow flowers, so popular throughout Polynesia. The whale-tooth necklaces of Samoa and the neighboring islands were really attractive, and were so highly valued that only kings and the most powerful chiefs could afford or dare to wear them. They consisted simply of the natural teeth perforated for stringing. They are now rare and seldom seen. Those at present used in the same district are lighter, more slender and artistic, but are made in England and sent out to the islands for trading. An interesting neck ornament was the *palaoa* of the Hawaiians. It consisted of a carved and polished piece of bone and ivory attached to an elaborately braided decoration of black hair. This ornament was worn only by chiefs of high rank and had some talismanic virtue. Among the necklaces from Australia are those consisting of kangaroo-teeth strung on thread, and the carefully made and really beautiful ones composed of cassowary feathers. Necklaces of trophies of dangerous hunting, analogous to that from Duruthy Cavern already mentioned, are made by Indian hunters from claws of the royal Bengal tiger. From the same materials the skillful goldsmiths of India make marvels of beautiful work. Such a one lies before me. The claws are perfectly cleaned and polished, mounted in gold settings, and strung on a chain of gold; pendent at the lower end is a pretty tiger and a charm, both of gold. Hundreds of years of time and generation of art development lie between the necklaces of Duruthy and Bengal! One of the most instructive lessons in culture history is shown by two South African necklaces described by Wood. The lesson is this: *in any art development, as new materials are gained, the*

FIG. 3.—NECKLACE OF WHALE'S TEETH. SAMOA.

old types are copied in the new material. One of these necklaces consists of beads and teeth. Six or seven fine leather thongs are strung with black beads of small size; rows one and a half inch long being made, a single bead of larger size, and in color white spotted with blue, is added; then follows another inch and a half of black beads; then comes a cluster of leopards' teeth three to five in number; this arrangement is repeated. The other necklace copies this in general plan. Rows of white beads are followed by a brass tooth; then come ruby-red beads with white spots; then another brass tooth, white beads, etc. The necklace with real teeth is of an older type than the other, and it is interesting, even after metal has been introduced and the *ornamental* and not the *trophy* idea prevails, to see the old trophy pattern carried over into a new and artificial material. Patterns survive.

Arm-bands and bracelets occur in great variety, but little need be said of them. Two African forms only will detain us. Among the Kaffirs, and in the west of Africa as well, a plain ivory arm-ring, in a single piece, is in common use. Such are easily made. The tusk of the elephant is hollow save near the small end. Toward the larger end the ivory sheath is thin and irregular, but it thickens and becomes solid toward the tip. All that is necessary to make arm-bands is to remove the soft, vascular inner part and then to cut the ivory into cross-sections, two or three inches wide. The rings thus made vary, of course, in size. After being cut they are carefully polished. With such rings the whole arm from wrist to elbow is often covered. Schweinfurth describes a pretty ornament of metal rings—the *dagobar*—as in use among White Nile tribes. The individual rings are of iron and are narrow and neatly made. They are worn so closely together upon the arm as to make a continuous metal

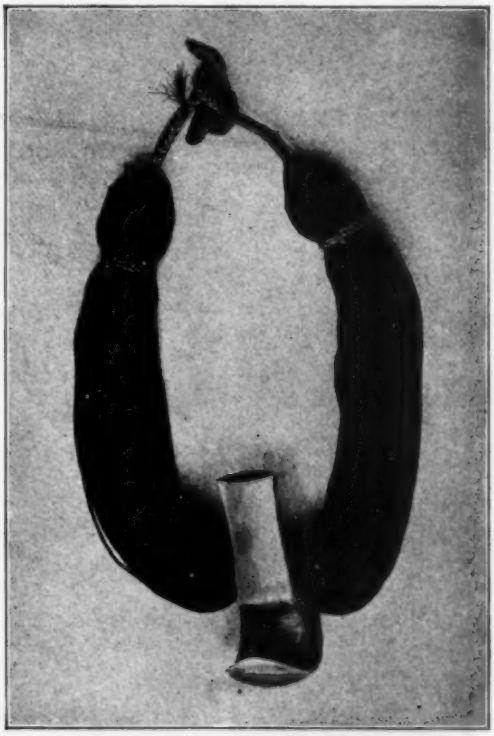

FIG. 4.—PALOA. Hawaiian Islands.

sheathing. Very curious are the arm-coils from Bouka Bay, New Guinea, which consist of one spiral strip of bark. *Ear-rings* are found in all times and among almost every people. They range in

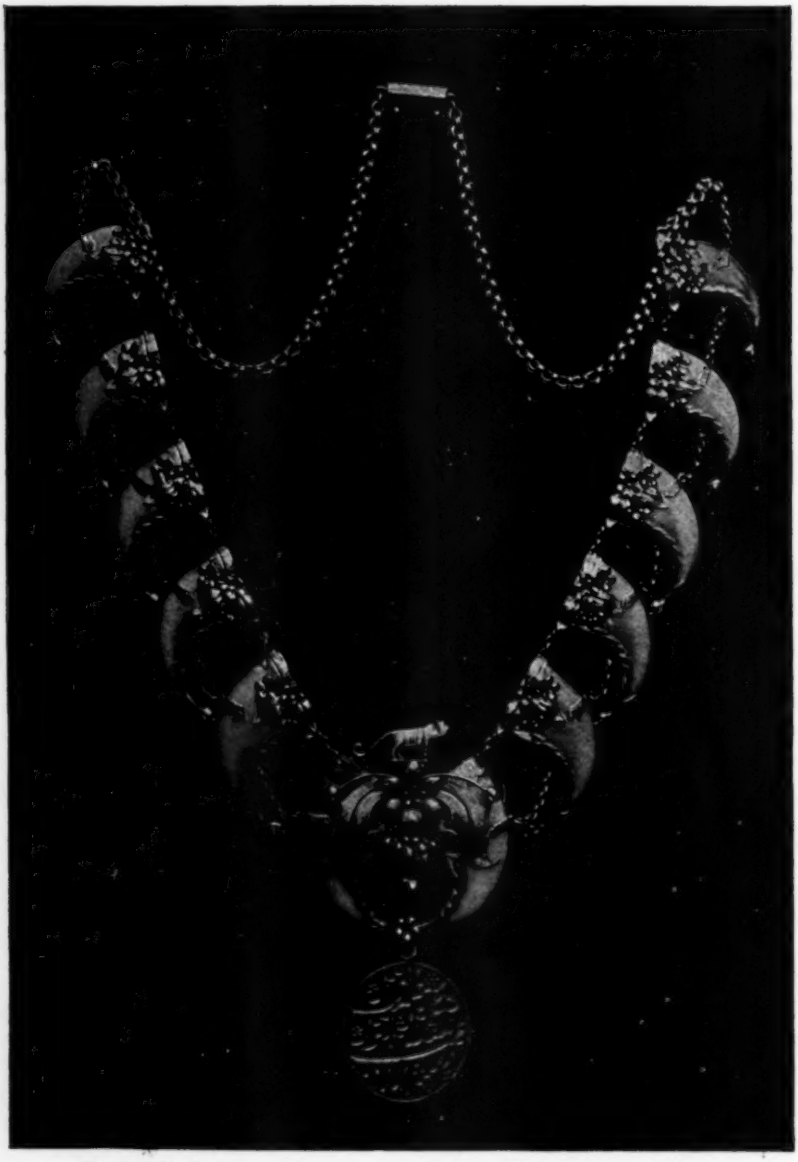

FIG. 5.—NECKLACE OF TIGER-CLAWS. India. (Miss Abbie M. White.)

size, material, and elegance from the brilliant solitaire in gold setting, worn by our ladies, to the bird-skins worn in the ears in New Zealand or the immense ornaments of shell with carved ivory in-

laying, from New Guinea. King Munza's sister begged lead bullets from Schweinfurth and hammered from them bright ear-rings. From New Zealand come very pretty ear-rings of green jade in the shape of sharks' teeth. Is it not certain that we here have another example of the law of copying an old form in a new material? Did the New Zealanders not wear *real* sharks' teeth, as some Alaskan and British Columbian tribes do now, before they made these more beautiful ones? *Waist-girdles* are interesting, not only in themselves, but also because of their influence upon dress development, already traced. In Australia they are often made of finely twisted human hair. Unique in material and really attractive in appearance are the Hottentot girdles made by stringing concave-convex disks of ostrich-egg shell. Such cords looked like a rope of ivory, and sometimes passed quite around the body. *Nose ornaments and labrets* were spoken of in the lecture on *Deformations*, and we care little to add to what is there said. Mr. Kunz recently showed us some interesting labrets made by the old Mexicans from jade and amethyst that show skillful work. These are all of the hat-shaped pattern, and the one of jade is very large. Were not some of the oldest ornaments known supposed to be *hair-pins*, we should hardly refer to these. From the lake dwellings of Switzerland we have a large number of these objects very neatly made, in a variety of large and ornamental patterns, from bronze. Vast quantities of bronze ornaments of all kinds—rings, arm-bands, wristlets, hair-pins, pendants, etc., have been found on these sites. *Feathers* are often worked up into wonderfully beautiful decorations. Some Upper Nile peoples use the "supple breast-feathers of the gray pelican, making them up into close perukes, which form excellent imitations of a luxuriant crop of gray hair." The head-dresses of bird-of-paradise feathers from the South Seas are beautiful in colors and graceful in form. The New Zealander made an elegant head-dress of pelican feathers, arranged in white bunches as wings on each side of the head, meeting above. The "war-bonnets" of eagle feathers, and the single, neatly wrapped and decorated feathers worn by American tribes, are well known. In this connection we may see how ornaments may indirectly en-

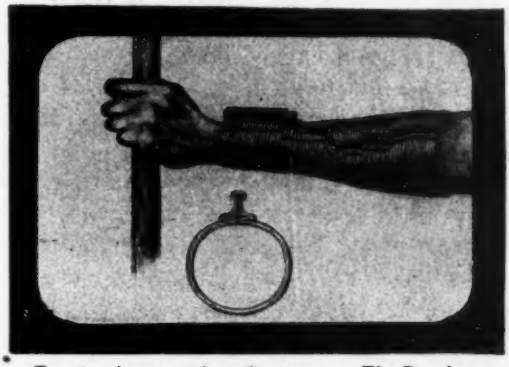

FIG. 6.—AFRICAN ARM ORNAMENT. The Dagobar.

courage art. Such delicate and perishable ornaments need especial protection from dust and injury. Receptacles of some sort must be provided, and usually such would themselves be decorated. In buying war feathers from the Sacs and Foxes, we found them kept in neatly made wooden boxes with slide covers. These boxes were usually carved and painted. The New Zealander for his choicest feathers made, with an infinity of toil and pains, elegant carved boxes of hard green jade.

Pendants have been used from an early date and are much prized by barbarous people. Akin to them are all sorts of breastplates, brooches, etc. Wood describes the *dibbi-dibbi* of the Australian. This is ordinarily fan-shaped and made of shell. It is also, however, at times crescentic and nearly as large as a cheese-plate. They are ornamented with drilled and engraved designs. Very much like them are the shell gorgets that have been found in the mounds of Tennessee, Georgia, and Missouri.

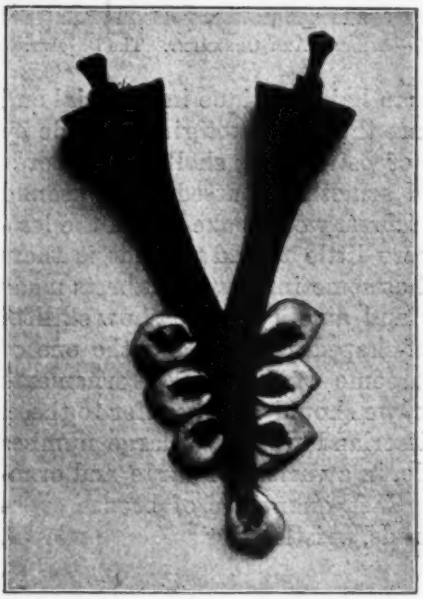

FIG. 7.—NOSE ORNAMENT. New Guinea.

They are among the finest specimens of art from the mounds. From two to five or six inches in diameter, these are disks, neatly carved from shell. The upper surface is concave and usually bears a carved design, often conventional but always well done—a spider, a rattlesnake, combinations of circles, spirals, and dots, a human figure, etc. While speaking of ornaments of this shape and size we may refer to the *sakahon* of the Sacs and Foxes. These are still made by the native jewelers from German silver. Those worn by men are pendent; those for women have a pin for attachment, forming what is called a *fibula*. These *sakahon* are ingeniously made and are worn in great numbers—one little girl's dance-waist bore two hundred of them. They are usually about an inch and a half in size. Among our Iowa Indians these pinning sakahon are only used by women, but Mrs. Harriet Maxwell Converse has a great number of very small ones, of silver, not more than a half-inch in diameter, which were formerly worn by the famous Iroquois orator Red Jacket. *Beads* are highly prized. The earliest were made of shell or stone, and later these were

copied in glass and metals. Glass beads have gone the world over. They have replaced many old materials, and have wrought great changes in many lines of aboriginal art work. But, there are beads and beads! Fashion changes as often among savages as with ourselves, and the bead so highly prized to-day may be worthless to-morrow. In Africa iron beads are always good, but glass beads fluctuate. One author tells us "they prefer as beads the '*mandyoor*'—long polyhedral prisms as large as a bean and as blue as lapis lazuli." But woe to the trader who took a stock of *mandyoor* there to-day! They might be a drug on the market. It may seem as if we have been too detailed in describing all these savage and barbaric decorations. We have simply aimed to show how varied in material and how diversified in form and use such ornaments may be. To show the profusion of ornament worn in some cases, and to illustrate the amount of discomfort which one will willingly endure for the sake of display, we quote a few descriptions:

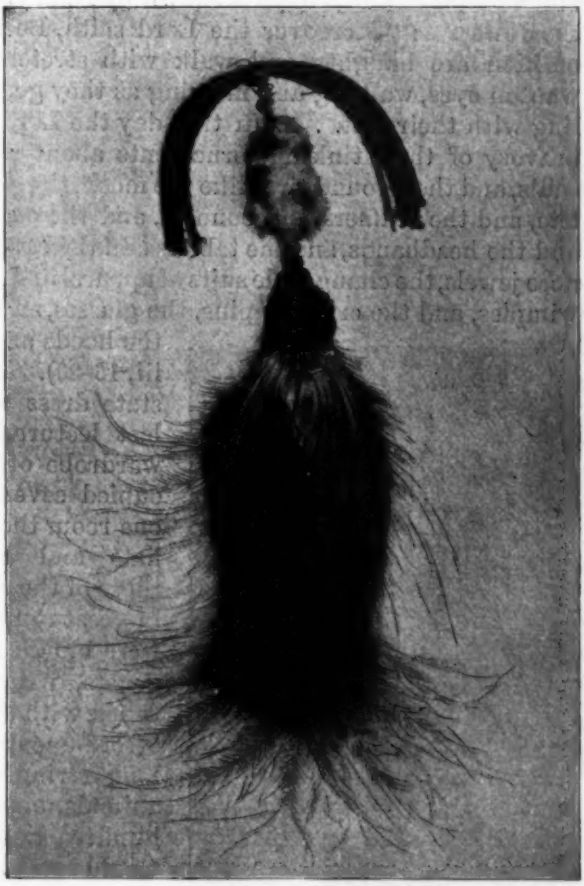

FIG. 8.—HEAD-DRESS OF BIRD-OF-PARADISE FEATHERS. South Sea Islands.

Livingstone describes the sister of chief Sebatuane as "wearing eighteen solid brass rings as thick as one's finger on each leg; three of copper under each knee; nineteen brass rings on the right arm; eight of brass and copper on the left arm, and a large ivory ring above each elbow. She had a heavy bead sash around her waist and a bead necklace. The weight of rings upon

her ankles was so great as to necessitate wrapping these with rags." Nubian women are particularly fond of silver, often wearing several watch-chains, three pairs of bracelets, bangles, ankle and leg ornaments, hair-pins, etc. That things were not much better in olden days is shown by Isaiah's remarks regarding the Jewesses: "Moreover the Lord saith, Because the daughters of Zion are haughty, and walk with stretched-forth necks and wanton eyes, walking and mincing as they go, and making a tinkling with their feet. . . . In that day the Lord will take away the bravery of their tinkling ornaments about their feet, and their cauls, and their round tires like the moon, the chains, and the bracelets, and the mufflers, the bonnets, and the ornaments of the legs, and the headbands, and the tablets and the ear-rings, the rings and nose jewels, the changeable suits of apparel and the mantles, and the wimples, and the crisping pins, the glasses, and the fine linen, and the hoods and the veils" (Isaiah, iii, 16–23). King Munza, whose state dress we spoke of in the last lecture, had an extensive wardrobe of ornaments. It occupied several apartments. In one room there was nothing but hats and feathers, especially those of the red parrot, arranged in great round tufts. In one hut were bundles of tails of civets, genets, patamochoeri, and giraffes, with skins and thousands of ornaments. There were also long strings of teeth of rare animals, one of more than one hundred lions' fangs. Surely it would seem that he had enough. An even more striking illustration of discomfort endured for the sake of display than that of Sebatuane's sister is the African belle who wore copper arm-rings which became so hot in the sun's rays that she was obliged to have an attendant with a watering-pot who would from time to time drench her to cool the metal.

FIG. 9.—SAMOAN CHIEF WITH ORNAMENTS.

We have already said that the desire for ornament has led to much material progress. We believe that to it must be attributed the origin and development of metal-working. The evidence of this will be found in an examination of the metal-work of various primitive peoples. The bronze relics from the Swiss lakes are exceedingly various, but much the larger number of them are

ornaments—not weapons or instruments. So in Africa, although it is true that the natives make wonderful assegai-blades, we believe that they use both copper and iron far more for leg-bands, arm-rings, and other decorations, than for articles of utility. As due to the ornament-search of man, metal-working possesses a special interest for us, and its beginnings deserve consideration. The first steps are well shown in North America. Here not only the recent tribes but also the builders of the mounds used native copper from Lake Superior. This was not smelted, but was beaten into shape with hammers of stone. Thin sheets were also beaten out between two stones and used for covering wooden forms. Prof. Putnam has found some very interesting spool-shaped ear ornaments of copper in Ohio mounds. These are not easy to describe, but they are very ingeniously made. They consist of two convex-concave disks of beaten copper, from an inch to two inches in diameter, held together by a narrow column of rolled copper-sheet. Such have been found in other metals as well as in copper. In one *altar mound* of the Turner group were found two bushels of ornaments of stone, copper, mica, shells, teeth, pearls, etc., nearly all perforated for suspension. Several copper ornaments, viz., bracelets, beads, and ear ornaments, were coated with beaten silver; one copper pendant was covered with beaten gold; one ear ornament of copper was covered with meteoric iron, and half of one of these ornaments was composed entirely of this latter metal.

FIG. 10.—NUBIAN GIRL WITH NOSE ORNAMENT.

Just how smelting arose we do not know. It may have been an accidental discovery, but, if so, the accident must have occurred in different places and at different times, as there is good evidence that the art has independently originated at several centers. In western Europe bronze preceded iron. In the heart of Africa it seems as if there had been no bronze age before the iron age. The Africans are often remarkable smiths, producing an excellent quality of iron with a very primitive outfit. The bellows consist of two wooden or pottery bowls with bladder tops, or of leather sacks; from these run pipes made of wood or of antelope horns;

the tips of these are incased in a clay tube. Wooden sticks are fastened to the middle of the bladder covers or to the upper end of the skins. By working these handles up and down air is forced through the pipes into the tube and through the fire. This is built in a hole dug in the ground. The heated iron is worked hot between two stones used as anvil and hammer. Assegai-blades are made with this poor outfit of such excellence that they may be sharpened so as to be used as razors, and so pliable that they may be bent double and then straightened after reheating. This is iron working, not smelting. Schweinfurth describes how the Dyoor get the iron from the ore, and the process is practically the same throughout Africa. In March, just before seeding-time, he says, they go to the woods to smelt iron. In the shaded center of a very wooded spot they make groups of furnaces of clay. These are cones not more than four feet high, widening to a goblet shape. A cup-shaped cavity at the top communicates by a small throat with the main cavity of the furnace, which is filled

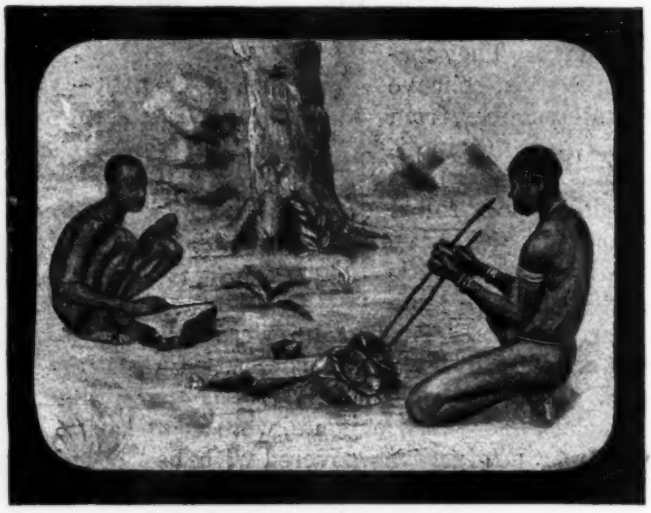

FIG. 11.—AFRICAN SMITHS AT WORK.

with charcoal. The upper receiver is filled with fragments of ore about a cubic inch in size. The hollow tunnel extends lower than the ground-level, and the melted ore, finding its way down through the fire, collects below. Openings here admit air and allow the withdrawal of slag. The iron has to be twice heated, and when taken out is in small bits which on reheating are beaten into one mass.

Metal-working had doubtless an exceedingly slow development; but it is remarkable how some people, strangers to the art as originators, acquire it as imitators. Thus the Sacs and Foxes

smelt no ores, but a dozen men in the tribe make from German silver neat and tasteful bracelets, armlets, rings, *sakahon*, and ear-rings. The jeweler's outfit consists of a square block of wood for an anvil, a hammer, a pair of shears, compasses, and a set of rude punches made from scrap iron, steel nails, bits of old files, etc. To make a finger-ring, the workman selects a piece of German silver and cuts from it a narrow strip long enough to encircle the finger. A square, rectangular, or oval piece of copper may be cut for a setting. This is marked with a neat design worked on with punches tapped by a hammer. The strip of white metal is bent into ring-form, the setting is laid upon it at the junction where the ends meet, and the two are firmly held together by a brass wire passed around them. A drop of solder is put upon the junction inside, a small stick is thrust through the ring to support it, and it is held in an open fire until the solder melts, flowing into the junction and cementing the whole firmly. After cooling, the ring is smoothed with a file and polished.

Sometimes we find the same object serving at once ornamental and useful purposes. The arm-rings of metal or ivory with which the African delights to cover his arms to the elbow are a useful protection against weapons. The metal rings worn by Latuka warriors on their right wrists are set with four or five sharp-edged knife-blades and are terrible weapons. The Isenga wear rings of considerable weight and sharp-edged; usually these are incased in leather sheaths, but, when uncovered, they become horrid weapons for hand-to-hand fighting. The very heavy arm-bands of the Wakamba are of triple use, serving at once as ornaments, parries, and striking weapons. Ornament often becomes money. The Nubian woman or the Hindoo frequently carries the family wealth on her person as silver ornaments. The important influence of ornament upon dress has already been considered in a preceding lecture.

We know of only one paper which treats at all fully of ornament. It is by Mougeolles. Although we do not concur in all the conclusions of this author, we wish to call attention to some propositions that he lays down. With the statement of these and of one or two additional, we shall close:

(*a*) *With the growth of dress, ornament declined.* If our view as to how dress developed is correct, this is natural. If dress began as ornament, the ornamental idea would gradually disappear as it passed into a modesty-covering and a bodily protection. As dress develops, the *sort* of ornament must change: ornament at first attached to the person, gradually passes into ornament attached to the dress. We notice here again an example of woman's conservatism. Man in civilization wears little ornament, and what he does wear is fastened to the dress; woman wears more

ornaments, and these are frequently attached to the person. Man in civilization still wears ornament "when he is a warrior, an officer, or a courtier." In all these cases we simply have *survival* of ornament in these conservative relations.

(*b*) *The search for ornament is as universal as the social inequality from which it has been derived.* We have seen that in its very beginnings ornament was a distinction. It was intended to mark a man from his fellows as one who had done what others had not accomplished. As the mark of social inequality it will exist wherever class distinctions are recognized.

(*c*) *Jewelry in ornament tends to grow more and more delicate with advancing civilization, and finally disappears as social distinctions vanish.* The first part of the proposition is shown by history. Ornament may be traced in Egypt, Greece, and Rome, and wherever there is actual progress toward true civilization ornament dwindles. The proposition as a whole grows out of the preceding. There is no place for ornaments in a true democracy where equality prevails. A revival of ornament indicates the retardation of democratic ideas.

(*d*) In our first lecture we referred to mutilations made to admit of ornament-carrying. We saw that ears, noses, cheeks, lips, and other parts are or have been pierced for insertion of ornaments. These *mutilations tend to disappear with advancement, and those which are most painful disappear first.* The least painful of these is ear-piercing, and we know that it still lingers in many cases where all other mutilations have disappeared.

(*e*) *In ornament as in dress we find much in the way of survival that is interesting.* Mougeolles claims that in the various head ornaments used as emblems of rank or power we have bits of history. He maintains that in very ancient Egypt masks were worn by hunters and warriors of the heads of slain animals. These are represented upon gods and goddesses in the *bas-reliefs.* The most commonly represented are made from heads of lions, jackals, etc. Isis wears a beef's head. Dog-headed figures are common. These animal head-dresses copied in other material continue in use, and, gradually conventionalized, lose their original form. He believes the crown was derived from a lion's head, the miter from that of a jackal, the Greek helmet from a horse's head.

(*f*) *Notice the importance, in its results, of personal vanity.* Without it we believe that man would have remained low in civilization. To the desire to mark himself off from his fellows by a visible sign we owe dress development; to it we owe a long list of important arts, chief among them perhaps that of metal-working; to it we owe much of the scientific method of studying the world around us: for, impelled by it, man first began to investigate Nature, beyond what was necessary to secure a food-supply

and bodily protection; to it we owe the development of our æsthetic sense in large degree. It may be true that to-day in a civilized democracy there is no proper place for personal ornament and decoration; but we can forgive much of weak display and many a useless survival of the past on account of what personal vanity has done for man's progress.

SOME OF THE POSSIBILITIES OF ECONOMIC BOTANY.*

By GEORGE LINCOLN GOODALE.

OUR Association demands of its president, on his retirement from office, some account of matters connected with the department of science in which he is engaged.

But you will naturally expect that, before I enter upon the discharge of this duty, I should present a report respecting the mission with which you intrusted me last year. You desired me to attend the annual meeting of the Australasian Association for the Advancement of Science, and express your good wishes for its success. Compliance with your request did not necessitate any material change in plans formed long ago to visit the South Seas; some of the dates and the sequence of places had to be modified; otherwise the early plans were fully carried out.

I can assure you that it seemed very strange to reverse the seasons, and find midsummer in January. But in the meeting with our brethren of the southern hemisphere nothing else was reversed. The official welcome to your representative was as cordial and the response by the members was as kindly as that which the people in the northern hemisphere would give to any fellow-worker coming from beyond the sea.

The meeting to which I was commissioned was held in January last in the cathedral city of Christchurch, New Zealand, the seat of Canterbury College.

Considering the distance between the other colonies and New Zealand, the meeting was well attended. From Hobart, Tasmania, to the southern harbor, known as the Bluff, in New Zealand, the sea voyage is only a little short of one thousand miles of rough water. From Sydney in New South Wales to Auckland, New Zealand, it is over twelve hundred miles. If, therefore, one journeys from Adelaide in South Australia, to Christchurch, New Zealand, where the meeting was held, he travels by land and by

* Presidential address delivered before the American Association for the Advancement of Science, at Washington, August, 1891.

sea over two thousand miles. From Brisbane in Queensland, it is somewhat farther. Although certain concessions are made to the members of the Association, the fares by rail and by steamship are high, so that a journey from any one of the seats of learning in Australia proper to New Zealand is formidable on account of its cost. It is remarkable that so large a number of members should have met together under such circumstances, and it speaks well for the great strength and vigor of the Association.

The Australasian Association is modeled rather more closely after the British Association than is our own. The president delivers his address upon his inauguration. There are no general business meetings, but all the details are attended to by an executive committee answering to our council; none except the members and associates are invited to attend even the sectional meetings, and there are some other differences between the three associations. The secretaries stated to me their conviction that their organization and methods are better adapted to their surroundings than ours would be, and all their arguments seemed cogent. Although the Association has been in existence but three years, it has accomplished great good. It has brought together workers in different fields for conference and mutual benefit; it has diminished misunderstandings, and has strengthened friendships. In short, it is doing the same kind of good work that we believe ours is now doing, and in much the same way.

Your message was delivered at the general evening session immediately before the induction of the new officers. The retiring president, Baron von Mueller, and the incoming president, Sir James Hector, in welcoming your representative, expressed their pleasure that you should have seen fit to send personal greetings.

In replying to their welcome, I endeavored to convey your felicitations upon the pronounced success of the Association, and your best wishes for a prosperous future. In your name I extended a cordial invitation to the members to gratify us by their presence at some of our annual meetings, and I have good reason to believe that this invitation will be accepted. I know it will be most thoroughly and hospitably honored by us.

On the morning of the session to which I refer, we received in the daily papers a cable telegram relative to the Bering Sea difficulties (which were then in an acute stage). In your stead, I ventured to say, "In these days of disquieting dispatches, when there are rumors of trouble between Great Britain and the United States, it is pleasant to think that 'blood is thicker than water.'" This utterance was taken to mean that we are all English-speaking kinsmen, and, even before I had finished, the old proverb was received with prolonged applause.

The next meeting of the Australasian Association is to be held in Hobart, the capital of Tasmania, under the presidency of the Governor, Sir Robert Hamilton. The energetic secretaries, Prof. Liversidge, Prof. Hutton, and Mr. Morton, promise a cordial welcome to any of our members visiting the Association. Should you accept the invitation, you will enjoy every feature of the remarkable island, Tasmania, where the meeting is to be held. You will be delighted by Tasmanian scenery, vegetation, and climate; but that which will give you the greatest enjoyment in this as in other English South Sea colonies is the fact that you are among English-speaking friends half-way around the world. You will find that their efficient Association is devoted to the advancement of science and the promotion of sound learning. In short, you will be made to feel at home.

The subject which I have selected for the valedictory address deals with certain industrial, commercial, and economic questions: nevertheless, it lies wholly within the domain of botany. I invite you to examine with me some of the possibilities of economic botany.

Of course, when treating a topic which is so largely speculative as this, it is difficult and unwise to draw a hard and fast line between possibilities and probabilities. Nowadays possibilities are so often realized rapidly that they become accomplished facts before we are aware.

In asking what are the possibilities that other plants than those we now use may be utilized we enter upon a many-sided inquiry.* Speculation is rife as to the coming man. May we not ask what plants the coming man will use?

There is an enormous disproportion between the total number of species of plants known to botanical science and the number of those which are employed by man.

The species of flowering plants already described and named are about one hundred and seven thousand. Acquisitions from unexplored or imperfectly explored regions may increase the aggregate perhaps one tenth, so that we are within very safe limits

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* The following are among the more useful works of a general character dealing with the subject. Others are referred to either in the text or notes. The reader may consult also the list of works on Economic Botany in the catalogue published by the Linnean Society.

Select Extra-tropical Plants, readily Eligible for Industrial Culture or Naturalization, with Indications of their Native Countries and some of their Uses. By Baron Ferd. von Mueller, K. C. M. G., F. R. S., etc., Government Botanist for Victoria. Melbourne, 1888. Seventh edition, revised and enlarged.

At the close of his treatise on industrial plants, Baron von Mueller has grouped the genera indicating the different classes of useful products in such a manner that we can ascertain the respective numbers belonging to the genera. Of course, many of these

in taking the number of existing species to be somewhat above one hundred and ten thousand.*

Now, if we should make a comprehensive list of all the flowering plants which are cultivated on what we may call a fairly large scale at the present day, placing therein all food † and forage plants, all those which are grown for timber and cabinet woods, for fibers and cordage, for tanning materials, dyes, resins, rubber, gums, oils, perfumes, and medicines, we could bring together barely three hundred species. If we should add to this short catalogue all the species which, without cultivation, can be used by man, we should find it considerably lengthened. A great many products of the classes just referred to are derived in commerce from wild plants, but exactly how much their addition would extend the list it is impossible in the present state of knowledge to determine. Every enumeration of this character is likely to contain errors from two sources: first, it would be sure to contain some species which have outlived their real usefulness, and, secondly, owing to the chaotic condition of the literature of the subject, omissions would occur.

But after all proper exclusions and additions have been made

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genera figure in more than one category. He has also arranged the plants according to the countries *naturally producing them.*

Useful Native Plants of Australia (including Tasmania). By J. H. Maiden, F. L. S., Curator of the Technological Museum of New South Wales, Sydney. Sydney, 1889.

See also note (*), page 71.

Hand-book of Commercial Geography. By Geo. G. Chisholm, M. A., B. Sc. London, 1889.

New Commercial Plants, with Directions how to grow them to the Best Advantage. By Thomas Christy. London, Christy & Co.

Dictionary of Popular Names of the Plants which furnish the Natural and Acquired Wants of Man. By John Smith, A. L. S. London, 1885.

Cultivated Plants: Their Propagation and Improvement. By F. W. Burbage. London, 1877.

The Wanderings of Plants and Animals from their First home. By Victor Hehn, edited by James Steven Stallybrass. London, 1885.

Researches into the Early History of Mankind, and the Development of Civilization. By Edward B. Tylor, D. C. L., LL.D., F.R. S. 1878.

* The number of species of *Phænogamia* has been given by many writers as not far from 150,000. But the total number of species recognized by Bentham and Hooker, in the Genera Plantarum (Durand's Index), is 100,220, in 210 natural orders and 8,417 genera.

† Dr. E. Lewis Sturtevant, to whose kindness I am indebted for great assistance in the matter of references, has placed at my disposal many of his notes on edible plants, etc. From his enumeration it appears that, if we count all the plants which have been cultivated for food at one time or another, the list contains 1,192 species; but if we count all the plants which either "habitally or during famine periods are recorded to have been eaten," we obtain a list of no less than 4,690 species, or about three and one half per cent of all known species of plants. But, as Sir Joseph Hooker has said, the products of many plants, though eatable, are not fit to eat.

the total number of species of flowering plants utilized to any considerable extent by man in his civilized state does not exceed, in fact it does not quite reach, one per cent.

The disproportion between the plants which are known and those which are used becomes much greater when we take into account the species of flowerless plants also. Of the five hundred ferns and their allies we employ for other than decorative purposes only five; the mosses and liverworts, roughly estimated at five hundred species, have only four which are directly used by man. There are comparatively few algæ, fungi, or lichens which have extended use.

Therefore, when we take the flowering and flowerless together, the percentage of utilized plants falls far below the estimate made for the flowering alone.

Such a ratio between the number of species known and the number used justifies the inquiry which I have proposed for discussion at this name—namely, Can the short list of useful plants be increased to advantage? If so, how?

This is a practical question; it is likewise a very old one. In one form or another, by one people or another, it has been asked from early times. In the dawn of civilization, mankind inherited from savage ancestors certain plants, which had been found amenable to simple cultivation, and the products of these plants supplemented the spoils of the chase and of the sea. The question which we ask now was asked then. Wild plants were examined for new uses; primitive agriculture and horticulture extended their bounds in answer to this inquiry. Age after age has added slowly and cautiously to the list of cultivable and utilizable plants, but the aggregate additions have been, as we have seen, comparatively slight.

The question has thus no charm of novelty, but it is as practical to-day as in early ages. In fact, at the present time, in view of all the appliances at the command of modern science, and under the strong light cast by recent biological and technological research, the inquiry which we propose assumes great importance. One phase of it is being attentively and systematically regarded in the great experiment stations, another phase is being studied in the laboratories of chemistry and pharmacy, while still another presents itself in the museums of economic botany.

Our question may be put in other words, which are even more practical. What present likelihood is there that our tables may, one of these days, have other vegetables, fruits, and cereals than those which we use now? What chance is there that new fibers may supplement or even replace those which we spin and weave, that woven fabrics may take on new vegetable colors, that

flowers and leaves may yield new perfumes and flavors? What probability is there that new remedial agents may be found among plants neglected or now wholly unknown? The answer which I shall attempt is not in the nature of a prophecy; it can claim no higher rank than that of a reasonable conjecture.

At the outset it must be said that synthetic chemistry has made and is making some exceedingly short cuts across this field of research, giving us artificial dyes, odors, flavors, and medicinal substances of such excellence that it sometimes seems as if before long the old-fashioned chemical processes in the plant itself would play only a subordinate part. But although there is no telling where the triumphs of chemical synthesis will end, it is not probable that it will ever interfere essentially with certain classes of economic plants. It is impossible to conceive of a synthetic fiber or a synthetic fruit. Chemistry gives us fruit-ethers and fruit-acids, and after a while may provide us with a true artificial sugar and amorphous starch; but artificial fruits worth the eating or artificial fibers worth the spinning are not coming in our day.

Despite the extraordinary achievements of synthetic chemistry, the world must be content to accept, for a long time to come, the results of the intelligent labor of the cultivator of the soil and the explorer of the forest. Improvement of the good plants we now utilize, and the discovery of new ones, must remain the care of large numbers of diligent students and assiduous workmen. So that, in fact, our question resolves itself into this: Can these practical investigators hope to make any substantial advance?

It will be well to glance first at the manner in which our wild and cultivated plants have been singled out for use. We shall, in the case of each class, allude to the methods by which the selected plants have been improved, or their products fully utilized. Thus, looking the ground over, although not minutely, we can see what new plants are likely to be added to our list. Our illustrations can, at the best, be only fragmentary.

We shall not have time to treat the different divisions of the subject in precisely the proportions which would be demanded by an exhaustive essay; an address on an occasion like this must pass lightly over some matters which other opportunities for discussion could properly examine with great fullness. Unfortunately, some of the minor topics which must be thus passed by possess considerable popular interest; one of these is the first subordinate question introductory to our task, namely, How were our useful cultivated and wild plants selected for use?

A study of the early history of plants employed for ceremonial purposes, in religious solemnities, in incantations, and for medici-

nal uses shows how slender has sometimes been the claim of certain plants to the possession of any real utility. But some of the plants which have been brought to notice in these ways have afterward been found to be utilizable in some fashion or other. This is often seen in the cases of the plants which have been suggested for medicinal use through the absurd doctrine of signatures.*

It seems clear that, except in modern times, useful plants have been selected almost wholly by chance, and it may well be said that a selection by accident is no selection at all. Nowadays the new selections are based on analogy. One of the most striking illustrations of the modern method is afforded by the utilization of bamboo fiber for electric lamps.

Some of the classes of useful plants must be passed by without present discussion; others alluded to slightly; while still other groups fairly representative of selection and improvement will be more fully described. In this latter class would naturally come, of course, the food-plants known as

I. THE CEREALS.—Let us look first at these.

The species of grasses which yield these seed-like fruits, or, as we might call them for our purpose, seeds, are numerous;† twenty of them are cultivated largely in the Old World, but only six of them are likely to be very familiar to you, namely, wheat, rice, barley, oats, rye, and maize. The last of these is of American origin, despite doubts which have been cast upon it. It was not known in the Old World until after the discovery of the New. It has probably been very long in cultivation. The others all belong to the Old World. Wheat and barley have been cultivated from the earliest times; according to De Candolle, the chief authority in these matters, about four thousand years. Later came rye and oats, both of which have been known in cultivation for at least two thousand years. Even the shorter of these periods gives time enough for wide variation, and, as is to be expected, there are numerous varieties of them all. For instance, Vilmorin, in 1880, figured sixty-six varieties of wheat with plainly distinguishable characters.‡

If the Chinese records are to be trusted, rice has been cultivated for a period much longer than that assigned by our history and traditions to the other cereals, and the varieties are correspondingly numerous. It is said that in Japan above three hun-

* The Folk Lore of Plants. By T. F. Thiselton Dyer, 1889.

† In Dr. Sturtevant's list, 88 species of *Graminea* are counted as food-plants under cultivation, while the number of species in this order which can be or have been utilized as food amounts to 146. Our smaller number 20 comprises only those which have been grown on a large scale anywhere.

‡ "In Agricultural Museum at Poppelsdorf 600 varieties are exhibited."

dred varieties are grown on irrigated lands, and more than one hundred on uplands.*

With the possible exception of rice, not one of the species of cereals is certainly known in the wild state.† Now and then specimens have been gathered in the East which can be referred to the probable types from which our varieties have sprung, but doubt has been thrown upon every one of these cases. It has been shown conclusively that it is easy for a plant to escape from cultivation and persist in its new home even for a long time in a near approximation to cultivated form. Hence, we are forced to receive all statements regarding the wild forms with caution. But it may be safely said that if all the varieties of cereals which we now cultivate were to be swept out of existence, we could hardly know where to turn for wild species with which to begin again. We could not know with certainty.

To bring this fact a little more vividly to our minds, let us suppose a case. Let us imagine that a blight without parallel has brought to extinction all the forms of wheat, rice, rye, oats, barley, and maize now in cultivation, but without affecting the other grasses or any other form of vegetable food. Mankind would be obliged to subsist upon the other kindly fruits of the earth—upon root-crops, tubers, leguminous seeds, and so on. Some of the substitutions might be amusing in any other time than that of a threatened famine. Others would be far from appetizing under any condition, and only a few would be wholly satisfying even to the most pronounced vegetarian. In short, it would seem, from the first, that the cereals fill a place occupied by no other plants. The composition of the grains is theoretically and practically almost perfect as regards food ratio between the nitrogenous matters and the starch group; and the food value, as it is termed, is high. But, aside from these considerations, it would be seen that for safety of preservation through considerable periods, and for convenience of transportation, the cereals take highest rank. Pressure would come from every side to compel us to find equivalents for the lost grains. From this predicament I believe that the well-equipped experiment stations and the Agricultural Departments in Europe and America would by and by extricate us. Continuing this hypothetical case, let us next inquire how the stations would probably go to work in the up-hill task of making partially good a well-nigh irreparable loss.

The whole group of relatives of the lost cereals would be passed

* E. L. S. in letter, quoted from Seedsman's Catalogue.

† The best account of the early history of these and other cultivated plants can be found in the classical work of De Candolle, Origine des Plantes Cultivées (Paris), translated in the International Series, History of Cultivated Plants (New York). The reader should consult also Darwin's Animals and Plants under Domestication.

in strict review. Size of grain, strength and vigor and plasticity of stock, adaptability to different surroundings, and flexibility in variation would be examined with scrupulous care.

But the range of experiment would, under the circumstances, extend far beyond the relatives of our present cereals. It would embrace an examination of the other grasses which are even now cultivated for their grains, but which are so little known, outside of their own limit, that it is a surprise to hear about them. For example, the millets, great and small, would be investigated. These grains, so little known here, form an important crop in certain parts of the East. One of the leading authorities on the subject * states that the millets constitute "a more important crop" in India "than either rice or wheat, and are grown more extensively, being raised from Madras in the south to Rajputana in the north. They occupy about eighty-three per cent of the food-grain area in Bombay and Sinde, forty-one per cent in the Punjab, thirty-nine per cent in the central provinces," "in all about thirty million acres."

Having chosen proper subjects for experimenting, the cultivators would make use of certain well-known principles. By simple selection of the more desirable seeds, strains would be secured to suit definite wants, and these strains would be kept as races, or attempts would be made to intensify wished-for characters. By skillful hybridizing of the first, second, and higher orders, tendencies to wider variation would be obtained and the process of selection considerably expedited.†

It is out of our power to predict how much time would elapse before satisfactory substitutes for our cereals could be found. In the improvement of the grains of grasses other than those which have been very long under cultivation, experiments have been few, scattered, and indecisive. Therefore we are as badly off for time-ratios as are the geologists and archæologists in their statements of elapsed periods. It is impossible for us to ignore the fact that there appear to be occasions in the life of a species when it seems to be peculiarly susceptible to the influence of its sur-

* Food-grains of India, A. H. Church, London, 1886, p. 34. In this instructive work the reader will find much information regarding the less common articles of food. Of *Panicum frumentaceum*, Prof. Georgeson states in a letter that it is grown in Japan for its grain, which is used for food, but here would take rank as a fodder-plant.

† In order to avoid possible misapprehension, it should be stated that there are a few persons who hold that at least some of our cereals, and other cultivated plants, for that matter, have not undergone material improvement, but are essentially unmodified progeny. Under this view, if we could look back into the farthest past, we should see our cereals growing wild and in such admirable condition that we should unhesitatingly select them for immediate use. This extreme position is untenable. Again, there are a few extremists who hold that some plants under cultivation have reached their culminating point, and must now remain stationary or begin to retrograde.

roundings.* A species, like a carefully laden ship, represents a balancing of forces within and without. Disturbance may come through variation from within, as from a shifting of the cargo, or in some cases from without. We may suppose both forces to be active in producing variation, a change in the internal condition rendering the plant more susceptible to any change in its surroundings. Under the influence of any marked disturbance, a state of unstable equilibrium may be brought about, at which times the species as such is easily acted upon by very slight agencies.

One of the most marked of these derangements is a consequent of cross-breeding within the extreme limits of varieties. The resultant forms in such cases can persist only by close breeding or by propagation from buds or the equivalents of buds. Disturbances like these arise unexpectedly in the ordinary course of nature, giving us sports of various kinds. These critical periods, however, are not unwelcome, since skillful cultivators can take advantage of them. In this very field much has been accomplished. An attentive study of the sagacious work done by Thomas Andrew Knight shows to what extent this can be done.† But we must confess that it would be absolutely impossible to predict with certainty how long or how short would be the time before new cereals or acceptable equivalents for them would be provided. Upheld by the confidence which I have in the intelligence, ingenuity, and energy of our experiment stations, I may say that the time would not probably exceed that of two generations of our race, or half a century.

In now laying aside our hypothetical illustration, I venture to ask why it is that our experiment stations, and other institutions dealing with plants and their improvement, do not undertake investigations like those which I have sketched? Why are not some of the grasses other than our present cereals studied with reference to their adoption as food-grains? One of these species will naturally suggest itself to you all, namely, the wild rice of the lakes.‡ Observations have shown that, were it not for the

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* Gray's Botanical Text-Book, vols. i and ii.

† A Selection from the Physiological and Horticultural Papers published in the Transactions of the Royal and Horticultural Societies, by the late Thomas Andrew Knight, Esq., President of the Horticultural Society, London. London, 1841.

‡ Illustrations of the Manners and Customs and Condition of the North American Indians. By George Catlin. London, 1876. A reprint of the account published in 1841, of travels in 1832–'40. "Plate 278 is a party of Sioux, in bark canoes (purchased of the Chippewas), gathering the wild rice, which grows in immense fields around the shores of the rivers and lakes of these northern regions, and used by the Indians as an article of food. The mode of gathering it is curious and, as seen in the drawing, one woman paddles the canoe, while another with a stick in each hand bends the rice over the canoe with one and strikes it with the other, which shakes it into the canoe, which is constantly moving along until it is filled." Vol. ii, p. 208.

difficulty of harvesting these grains, which fall too easily when they are ripe, they might be utilized. But attentive search might find or educe some variety of *Zizania* with a more persistent grain and a better yield. There are two of our sea-shore grasses which have excellent grains, but are of small yield. Why are not these, or better ones which might be suggested by observation, taken in hand?

The reason is plain. We are all content to move along in lines of least resistance, and are disinclined to make a fresh start. It is merely leaving well enough alone, and, so far as the cereals are concerned, it is indeed well enough. The generous grains of modern varieties of wheat and barley compared with the well-preserved charred vestiges found in Greece by Schliemann,* and in the lake-dwellings,† are satisfactory in every respect. Improvements, however, are making in many directions; and in the cereals we now have we possess far better and more satisfactory material for further improvement, both in quality and as regards range of distribution, than we could reasonably hope to have from other grasses.

From the cereals we may turn to the interesting groups of plants comprised under the general term

II. VEGETABLES.—Under this term it will be convenient for us to include all plants which are employed for culinary purposes, or for table use, such as salads and relishes.

The potato and sweet potato, the pumpkin and squash, the red or capsicum peppers, and the tomato, are of American origin.

All the others are, most probably, natives of the Old World. Only one plant coming in this class has been derived from southern Australasia, namely, New Zealand spinach (*Tetragonia*).

Among the vegetables and salad-plants longest in cultivation

* Schliemann's carbonized specimens exhumed in Greece are said to be "very hard, fine-grained, sharp, very flat on grooved side, different from any wheats now known." American Antiquities, 1880, p. 66. The carbonized grains in the Peabody Museum at Cambridge, Mass., are small.

† Prehistoric Times as illustrated by Ancient Remains and the Manners and Customs of Modern Savages. By John Lubbock, Bart. New York, fourth edition, 1886. "Three varieties of wheat were cultivated by the lake-dwellers, who also possessed two kinds of barley and two of millet. Of these the most ancient and most important were the six-rowed barley and small "lake-dwellers'" wheat. The discovery of Egyptian wheat (*Triticum turgidum*), at Wangen and Robenhausen, is particularly interesting. Oats were cultivated during the bronze age, but are absent from all the stone age villages. Rye was also unknown" (p. 216). "Wheat is most common, having been discovered at Merlen, Moosseedorf, and Wangen. At the latter place, indeed, many bushels of it were found, the grains being in large, thick lumps. In other cases the grains are free, and without chaff, resembling our present wheat in size and form, while more rarely they are still in the ear." One hundred and fifteen species of plants have been identified (Heer, Keller).

we may enumerate the following: turnip, onion, cabbage, purslane, the large bean (*Faba*), chick-pea, lentil, and one species of pea, garden pea. To these an antiquity of at least four thousand years is ascribed.

Next to these, in point of age, come the radish, carrot, beet, garlic, garden cress and celery, lettuce, asparagus, and the leek. Three or four leguminous seeds are to be placed in the same category, as are also the black peppers.

Of more recent introduction the most prominent are the parsnip, oyster-plant, parsley, artichoke, endive, and spinach.

From these lists I have purposely omitted a few which belong exclusively to the tropics, such as certain yams.

The number of varieties of these vegetables is astounding. It is, of course, impossible to discriminate between closely allied varieties which have been introduced by gardeners and seedsmen under different names, but which are essentially identical, and we must therefore have recourse to a conservative authority, Vilmorin,* from whose work a few examples have been selected. The varieties which he accepts are sufficiently well distinguished to admit of description, and in most instances of delineation, without any danger of confusion. The potato has, he says, innumerable varieties, of which he accepts forty as easily distinguishable and worthy of a place in a general list, but he adds also a list, comprising, of course, synonyms, of thirty-two French, twenty-six English, nineteen American, and eighteen German varieties. The following numbers speak for themselves, all being selected in the same careful manner as those of the potato: celery, more than twenty; carrot, more than thirty; beet, radish, and potato, more than forty; lettuce and onion, more than fifty; turnip, more than seventy; cabbage, kidney-bean, and garden pea, more than one hundred.

The amount of horticultural work which these numbers represent is enormous. Each variety established as a race (that is, a variety which comes true to seed) has been evolved by the same sort of patient care and waiting which we have seen is necessary in the case of cereals, but the time of waiting has not been as a general thing so long.

You will permit me to quote from Vilmorin † also an account of a common plant, which will show how wide is the range of variation and how obscure are the indications in the wild plant of its available possibilities. The example shows how completely hidden are the potential variations useful to mankind:

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* *Les Plantes Potagères*, Vilmorin, Paris. Translated into English under the direction of W. Robinson, Editor of the (London) Garden, 1885, and entitled The Vegetable Garden.

† *Loc. cit.*, English edition, p. 104.

Cabbage, a plant which is indigenous in Europe and western Asia, is one of the vegetables which has been cultivated from the earliest time. The ancients were well acquainted with it, and certainly possessed several varieties of the head-forming kinds. The great antiquity of its culture may be inferred from the immense number of varieties which are now in existence, and from the very important modifications which have been produced in the characteristics in the original or parent plant.

The wild cabbage, such as it now exists on the coasts of England and France, is a perennial plant with broad-lobed, undulated, thick, smooth leaves, covered with a glaucous bloom. The stem attains a height of from nearly two and a half to over three feet, and bears at the top a spike of yellow or sometimes white flowers. All the cultivated varieties present the same peculiarities in their inflorescence, but up to the time of flowering they exhibit most marked differences from each other and from the original wild plant. In most of the cabbages it is chiefly the leaves that are developed by cultivation; these for the most part become imbricated or overlap one another closely, so as to form a more or less compact head, the heart or interior of which is composed of the central undeveloped shoot and the younger leaves next it. The shape of the head is spherical, sometimes flattened, sometimes conical. All the varieties which form heads in this way are known by the general name of cabbages, while other kinds with large branching leaves which never form heads are distinguished by the name of borecole or kale.

In some kinds the flower-stems have been so modified by culture as to become transformed into a thick, fleshy, tender mass, the growth and enlargement of which are produced at the expense of the flowers, which are absorbed and rendered abortive. Such are the broccolis and cauliflowers.

But this plant has other transformations.

In other kinds the leaves retain their ordinary dimensions, while the stem or principal root has been brought by cultivation to assume the shape of a large ball or turnip, as in the case of the plants known as kohl-rabi and turnip-rooted cabbage or Swedish turnip. And, lastly, there are varieties in which cultivation and selection have produced modifications in the ribs of the leaves, as in their couve tronchuda, or in the axillary shoots (as in Brussels sprouts), or in several organs together, as in the marrow kales and the Neapolitan curled kale.

Here are important morphological changes like those to which Prof. Bailey has called attention in the case of the tomato.

Suppose we are strolling along the beach at some of the seaside resorts of France, and should fall in with this coarse cruciferous plant, with its sprawling leaves and strong odor. Would there be anything in its appearance to lead us to search for its hidden merit as a food-plant? What could we see in it which would give it a preference over a score of other plants at our feet? Again, suppose we are journeying in the highlands of Peru, and should meet with a strong-smelling plant of the nightshade family, bearing a small irregular fruit, of subacid taste and of peculiar flavor. We will further imagine that the peculiar taste strikes our fancy, and we conceive that the plant has possibilities as a source of food. We should be led by our knowledge of the potato, probably a native of the same region, to think that this allied plant

might be safely transferred to a northern climate; but would there be promise of enough future usefulness, in such a case as this, to warrant our carrying the plant north as an article of food? Suppose, further, we should ascertain that the fruit in question was relished not only by the natives of its home, but that it had found favor among the tribes of south Mexico and Central America, and had been cultivated by them until it had attained a large size; should we be strengthened in our venture? Let us go one step further still. Suppose that having decided upon the introduction of the plant, and having urged everybody to try it, we should find it discarded as a fruit, but taking a place in gardens as a curiosity under an absurd name, or as a basis for preserves and pickles; should we not look upon our experiment in the introduction of this new plant as a failure? This is not a hypothetical case.

The tomato,* the plant in question, was cultivated in Europe as long ago as 1554;† it was known in Virginia in 1781 and in the Northern States in 1785; but it found its way into favor slowly, even in this land of its origin. A credible witness states that in Salem it was almost impossible to induce people to eat or even taste of the fruit. And yet, as you are well aware, its present cultivation on an enormous scale in Europe and this country is scarcely sufficient to meet the increasing demand.

A plant which belongs to the family of the tomato has been known to the public under the name of the strawberry tomato. The juicy yellow or orange-colored fruit is inclosed in a papery calyx of large size. The descriptions which were published when the plant was placed on the market were attractive, and were not exaggerated to a misleading extent. But, as you all know, the plant never gained any popularity. If we look at these two cases carefully we shall see that what appears to be caprice on the part of the public is at bottom common sense. The cases illustrate as well as any which are at command the difficulties which surround the whole subject of the introduction of new foods.

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* According to notes made by Mr. Manning, Secretary Massachusetts Horticultural Society (History Massachusetts Horticultural Society), the tomato was introduced into Salem, Mass., about 1802 by Michele Felice Corne, an Italian painter, but he found it difficult to persuade people even to taste the fruit (Felt's Annals of Salem, vol. ii, p. 631). It was said to have been introduced into Philadelphia by a French refugee from Santo Domingo in 1798. It was used as an article of food in New Orleans in 1812, but was not sold in the markets of Philadelphia until 1829. It did not come into general use in the North until some years after the last-named date.

† "In Spain and those hot regions, they use to eat the (love) apples prepared and boiled with pepper, salt, and olives; but they yield very little nourishment to the bodies, and the same nought and corrupt. Likewise they doe eat the apples with oile, vinegar, and pepper mixed together for sauce to their meat even as we in these Cold Countries do Mustard." (Gerard's Herbal, p. 346.)

Before asking specifically in what direction we shall look for new vegetables I must be pardoned for calling attention, in passing, to a very few of the many which are already in limited use in Europe and this country, but which merit a wider employment. Cardon, or cardoon; celeriac, or turnip-rooted celery; fetticus, or corn-salad; martynia; salsify; sea-kale; and numerous small salads, are examples of neglected treasures of the vegetable garden.

The following, which are even less known, may be mentioned as fairly promising:*

1. *Arracacia esculenta*, called arracacha, belonging to the parsley family. It is extensively cultivated in some of the northern states of South America. The stems are swollen near the base and produce tuberous enlargements filled with an excellent starch. Although the plant is of comparatively easy cultivation, efforts to introduce it into Europe have not been successful, but it is said to have found favor in both the Indies, and may prove useful in our Southern States.

2. *Ullucus* or ullucus, another tuberous-rooted plant from nearly the same region, but belonging to the beet or spinach family. It has produced tubers of good size in England, but they are too waxy in consistence to dispute the place of the better tubers of the potato. The plant is worth investigating for our hot, dry lands.

3. A tuber-bearing relative of our common hedge-nettle, or *Stachys*, is now cultivated on a large scale at Crosnes, in France, for the Paris market. Its name in Paris is taken from the locality where it is now grown for use. Although its native country is Japan, it is called by some seedsmen Chinese artichoke. At the present stage of cultivation the tubers are small and are rather hard to keep, but it is thought that, "both of these defects can be overcome or evaded."† Experiments indicate that we have in this species a valuable addition to our vegetables. We must next look at certain other neglected possibilities.

Dr. Edward Palmer,‡ whose energy as a collector and acute-

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* Commercial Botany of the Nineteenth Century. By John R. Jackson, A. L. S. Cassell & Co. London, 1890. Mr. Jackson, who is the Curator of the Museums, Royal Gardens, Kew, has embodied in this treatise a great amount of valuable information, well arranged for ready reference.

† Gardener's Chronicle, 1888.

‡ Department of Agriculture Report for 1870, pp. 404–428. Only those are here copied from Dr. Palmer's list which he expressly states are extensively used:

Ground-nut (*Apios tuberosa*); *Aesculus californica*; *Agave americana*; *Nuphar advena*; prairie potato (*Psoralea esculenta*); *Scirpus lacustris*; *Sagittaria variabilis*; kamass-root (*Camassia esculenta*); *Solanum Fendleri* (supposed by him to be the original of the cultivated potato); acorns of various sorts; mesquite (*Algarobia glandulosa*; *Juniperus occidentalis*; nuts of *Carya*, *Juglans*, etc.; screw-bean (*Strombocarpus pubescens*);

ness as an observer are known to you all, has brought together very interesting facts relative to the food-plants of our North American aborigines. Among the plants described by him there are a few which merit careful investigation. Against all of them, however, there lie the objections mentioned before, namely:

1. The long time required for their improvement, and—

2. The difficulty of making them acceptable to the community, involving—

3. The risk of total and mortifying failure.

In the notes to this address the more prominent of these are enumerated.

In 1854 the late Prof. Gray called attention to the remarkable relations which exist between the plants of Japan and those of our Eastern coast. You will remember that he not only proved that the plants of the two regions had a common origin, but also emphasized the fact that many species of the two countries are

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various cactaceæ; *Yucca;* cherries and many wild berries; *Chenopodium album*, etc. *Psoralea esculenta* = prairie potato, or bread-root. (Palmer in Agricultural Report, 1870, p. 402). The following from Catlin, *loc. cit.*, i, p. 122: "Corn and dried meat are generally laid in in the fall, in sufficient quantities to support them through the winter. These are the principal articles of food during that long and inclement season; and, in addition to them, they oftentimes have in store great quantities of dried squashes, and dried 'pommes blanches,' a kind of turnip which grows in great abundance in those regions. . . . These are dried in great quantities and pounded into a sort of meal and cooked with dried meat and corn. Great quantities also are dried and laid away in store for the winter season, such as buffalo-berries, service-berries, strawberries, and wild plums. In addition to this we had the luxury of service-berries without stint; and the buffalo bushes, which are peiarulc to these northern regions, lined the banks of the river and the defiles in the bluffs, sometimes for miles together, forming almost impassable hedges, so loaded with the weight of their fruit that their boughs everywhere gracefully bending down or resting on the ground. This last shrub (*Shepherdia*), which may be said to be the most beautiful ornament that decks out the wild prairies, forms a striking contrast to the rest of the foliage, from the blue appearance of its leaves by which it can be distinguished for miles in distance. The fruit which it produces in such incredible profusion, hanging in clusters to every limb and to every twig, is about the size of ordinary currants and not unlike them in color and even in flavor; being exceedingly acid, almost unpalatable, until they are bitten by frost of autumn, when they are sweetened and their flavor delicious, having to the taste much the character of grapes, and I am almost fain to think would produce excellent wine." (George Catlin's Illustrations and Manners, Customs, and Condition of the North American Indians, p. 72, vol. i.) For much relative to the food of our aborigines, especially of the Western coast, consult The Native Races of the Pacific States of North America. By H. H. Bancroft. New York, 1875. The following from vol. i, p. 538, indicates that inaccuracies have crept into the work: "From the earliest information we have of these nations" (the author is speaking of the New Mexicans), "they are known to have been tillers of the soil; and though the implements used and their methods of cultivation were both simple and primitive, cotton, corn, *wheat*, beans, and many varieties of fruits which constituted their principal food were raised in abundance." Wheat was not grown on the American continent until after the landing of the first explorers.

almost identical. It is to that country, which has yielded us so many useful and beautiful plants, that we turn for new vegetables to supplement our present food resources. One of these plants, namely, *Stachys*, has already been mentioned as rather promising. There are others which are worth examination and perhaps acquisition.

One of the most convenient places for a preliminary examination of the vegetables of Japan is at the railroad stations on the longer lines—for instance, that running from Tokio to Kobe. For native consumption there are prepared luncheon-boxes of two or three stories, provided with the simple and yet embarrassing chopsticks. It is worth the shock it causes one's nerves to invest in these boxes and try the vegetable contents. The bits of fish, flesh, and fowl which one finds therein can be easily separated and discarded, upon which there will remain a few delicacies. The pervading odor of the box is that of aromatic vinegar. The generous portion of boiled rice is of excellent quality with every grain well softened and distinct, and this without anything else would suffice for a tolerable meal. In the boxes which have fallen under my observation there were sundry boiled roots, shoots, and seeds which were not recognizable by me in their cooked form. Prof. Georgeson,* formerly of Japan, has kindly identified some of these for me, but he says, "There are doubtless many others used occasionally."

One may find sliced lotus roots, roots of large burdock, lily bulbs, shoots of ginger, pickled green plums, beans of many sorts, boiled chestnuts, nuts of the gingko tree, pickled greens of various kinds, dried cucumbers, and several kinds of sea-weeds. Some of the leaves and roots are cooked in much the same manner as beet roots and beet leaves are by us, and the general effect is not unappetizing. The boiled shoots are suggestive of only the tougher ends of asparagus. On the whole, I do not look back on Japanese railway luncheons with any longing which would compel me to advocate the indiscriminate introduction of the constituent vegetables here.

But when the same vegetables are served in native inns, under more favorable culinary conditions, without the flavor of vinegar

* Pickled daikon, the large radish, often grated. Ginger-roots—shoga. Beans (*Glycine hispida*), many kinds, and prepared in many ways. Beans (*Dolichos cultratus*), cooked in rice and mixed with it. Sliced hasu, lotus roots. Lily bulbs, boiled whole and the scales torn off as they are eaten. Pickled green plums (ume-boshi), colored red in the pickle by the leaves of *Perilla arguta* (shiso). Sliced and dried cucumbers, kiuri. Pieces of gobo—roots of *Lappa major*. Rakkio—bulbs of *Allium Bakeri*, boiled in shogu. Grated wasabi—stem of *Eutrema wasabi*. Water-cress—midzu-tagarashi (not often). Also sometimes pickled greens of various kinds, and occasionally chestnut-kernels boiled and mixed with a kind of sweet sauce. Nut of the gingko tree. Several kinds of sea-weeds are also very commonly served with the rice. Prof. C. C. Georgeson in letter.

and of the pine wood of the luncheon-boxes, they appear to be worthy of a trial in our horticulture, and I therefore deal with one or two in greater detail.

Prof. Georgeson, whose advantages for acquiring a knowledge of the useful plants of Japan have been unusually good, has placed me under great obligations by communicating certain facts regarding some of the more promising plants of Japan which are not now used here. It should be said that several of these plants have already attracted the notice of the Agricultural Department in this country.

The soy bean (*Glycine hispida*). This species is known here to some extent, but we do not have the early and best varieties. These beans replace meat in the diet of the common people.

Mucuna (*Mucuna capitata*) and dolichos (*Dolichos cultratus*) are pole-beans possessing merit.

Dioscorea; there are several varieties with palatable roots. Years ago one of these was spoken of by the late Dr. Gray as possessing "excellent roots, if one could only dig them."

Colocasia antiquorum has tuberous roots, which are nutritious.

Conophallus Konjak has a large bulbous root, which is sliced, dried, and beaten to a powder. It is an ingredient in cakes.

Aralia cordata is cultivated for the shoots, and used as we use asparagus.

Œnanthe stolonifera and *Cryptotænia canadensis* are palatable salad plants, the former being used also as greens.

There is little hope, if any, that we shall obtain from the hotter climates for our southern territory new species of merit. The native markets in the tropical cities, like Colombo, Batavia, Singapore, and Saigon, are rich in fruits, but, outside of the native plants bearing these, nearly all the plants appear to be wholly in established lines of cultivation, such, for instance, as members of the gourd and nightshade families.

Before we leave the subject of our coming vegetables, it will be well to note a *naïve* caution enjoined by Vilmorin in his work, Les Plantes Potagères.*

"Finally," he says, "we conclude the article devoted to each plant with a few remarks on the uses to which it may be applied and on the parts of the plants which are to be so used. In many cases such remarks may be looked upon as idle words, and yet it would sometimes have been useful to have them when new plants were cultivated by us for the first time. For instance, the giant edible burdock of Japan (*Lappa edulis*) was for a long time served up on our tables only as a wretchedly poor spinach, be-

* *Loc. cit.* Preface in English edition.

cause people would cook the leaves, whereas, in its native country, it is only cultivated for its tender, fleshy roots."

I trust you are not discouraged at this outlook for our coming vegetables.

Two groups of improvable food-plants may be referred to before we pass to the next class, namely, edible fungi and the beverage-plants. All botanists who have given attention to the matter agree with the late Dr. Curtis, of North Carolina, that we have in the unutilized mushrooms an immense amount of available nutriment of a delicious quality. It is not improbable that other fungi than our common "edible mushroom" will by and by be subjected to careful selection.

The principal beverage-plants—tea, coffee, and chocolate—are all attracting the assiduous attention of cultivators. The first of these plants is extending its range at a marvelous rate of rapidity through India and Ceylon; the second is threatened by the pests which have almost exterminated it in Ceylon, but a new species, with crosses therefrom, is promising to resist them successfully; the third, chocolate, is every year passing into lands farther from its original home. To these have been added the kola, of a value as yet not wholly determined, and others are to augment the short list.

[*To be concluded.*]

LESSONS FROM THE CENSUS.

By CARROLL D. WRIGHT, A.M.,
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II.

TO my own mind, the Federal census system is faulty in many features. It is bungling, unwieldy, and unproductive of scientific results. It is the legitimate growth of time and the honest endeavor to secure broader and broader results to satisfy the growing demand for information concerning all the conditions of the people, and it is perfectly natural that the additions from time to time should have resulted in the present system. The system should be changed radically before another census period comes around.

To be specific in the condemnation of our system, attention should be paid, first, to the method of enumeration. Vicious as it is, it is a vast improvement upon that existing prior to 1880. There are four methods of enumeration, or rather four methods of enumeration have been tried on pretty extensive scales. The English method consists in securing all the facts called for under

the law in one day. For this purpose a vast army of enumerators is appointed from the central office.* The organization under the British Census Act is under the control of the Local Government Board, and the immediate chief is the Registrar-General. Local registrars of births and deaths must divide their subdistricts into enumerators' divisions, in accordance with instructions from the Registrar-General, and subject to his final supervision and approval. Every registrar of births and deaths must furnish to his superintendent registrar lists containing names, occupations, and places of abode of a sufficient number of persons qualified, according to instructions, to act as enumerators within a subdistrict, and such persons, if approved by the superintendent registrar, shall be appointed enumerators for taking the census. The board causes to be prepared a table of allowances to be made to the several enumerators, registrars, superintendent registrars, and other persons employed in taking the census; and such table, when approved by the Treasury, is laid before both Houses of Parliament for their action. Under the act the schedule comprehends eleven inquiries, relating to the members of the family, visitors, boarders, and servants who slept or abode in the dwelling on the night of Sunday, April 5, 1891, and the schedule was called for on Monday, April 6th, by the appointed enumerator, whose business it was to see that the schedule was properly filled by the head of the household, and, if not, to cause it to be so filled. This method seems to be the one that attracts the attention of statisticians as the ideal method. Under it, however, much complaint exists in Great Britain, not only as to the processes of carrying out the law, but relative to the inaccuracies in the returns; and I have been informed that much difficulty is experienced in obtaining well-filled schedules. It is unreasonable to suppose that in a population varying widely in the intelligence of its individual members a schedule can be properly filled or so well filled as to secure a reasonably scientific result. The English census has been extolled for its accuracy. I do not believe it is any more accurate than any other census taken by other methods. I have before me a discarded schedule—that is, an improperly filled one—left with an intelligent mechanic, well educated, of wide experience, a machinist by trade, and perfectly competent to write an article for a magazine; and yet he could not, or did not, properly fill the schedule left with him, and on an examination of it it is not strange that he did not. When the difficulties of filling the simple English schedule are considered, it becomes pre-

* In an article in the North American Review for June, 1889, I stated that the English census was taken through the constabulary. I made this statement on most excellent authority. It was, however, an error.

posterous to suppose that the expanded schedule under the Federal system could be filled under the English method. This has been tried, and in a State where the population has been taught to consider the value of statistics—the Commonwealth of Massachusetts. In 1875 the English method was adopted; the schedules, comprehending all the inquiries at that time called for by law, were left with the heads of families, with clearly defined instructions, sample sheets, etc., all in accordance with the recognized English method; and from that community, which, it is reasonable to suppose, could fill the census schedules if any community could do it, but thirty-seven per cent of the returns were in a condition for use. The balance had to be corrected or made entirely by the enumerators. That method was therefore abandoned in subsequent censuses for the State of Massachusetts. With the sparsely settled population of the United States, and with the broad schedule of the Federal census, covering as it does twenty-four inquiries, it would be absurd to attempt to take the census under the English system.

In Germany the labor of enumeration is performed by persons who, in consideration of the public utility of the work, do it without compensation.* It has been thought that this feature could be embodied in the United States census to a certain extent, or at least supplemented by the employment of school-teachers in the enumeration. The German method involves, of course, the creation of exceedingly small enumeration districts, after the English method, a block in a city or a portion of a street in a town or village being allotted to some patriotic citizen who would without compensation see to it that the schedules were properly filled. It is doubtful if this method could be made useful in the United States. Our people are too busy—at least those competent to take charge of such work—to induce them to enlist. The great difficulty even now is to secure men for a week or a month's service under the Census Office.

The third method of enumeration is that practiced in the State of Massachusetts, and certainly the scientific results of the censuses of that State would indicate the value of the method employed. Since 1845 the Commonwealth of Massachusetts has taken a census regularly, on the mean year of the Federal censuses. It started its census work in 1837 by an account of its manufactures, etc.; but its first enumeration on any broad scale was in 1845, through the assessors of cities and towns. In 1875 the field work was done by enumerators appointed by the census authorities and paid by the day, and they were instructed to secure

* The History, Theory, and Technique of Statistics, by August Meitzen, Ph. D., professor at the University of Berlin. Falkner's translation.

full and complete results without regard to the time taken. For the population the English method was used, as already stated. The manufactures and agricultural products were secured on individual schedules, statements being certified to by proprietors. In 1885 the card schedule for population was successfully introduced, the other features of the 1875 system and per diem compensation being retained.

Under the Federal system, which I have said is so faulty, all data are collected, so far as population, agriculture, and the general statistics of manufacture are concerned, by enumerators selected by the supervisors and appointed by the Superintendent. The supervisors under the eleventh census are fairly compensated; the enumerators are not. The compensation for enumerating the population under the existing law is in most of the country two cents for each living inhabitant, two cents for each death reported, fifteen cents for each farm, twenty cents for each establishment of productive industry enumerated and returned, and five cents for each surviving soldier, sailor, or marine, or each widow of a soldier, sailor, or marine returned. In some subdivisions the allowance for each living inhabitant may be increased, but the compensation allowed to any enumerator in any difficult district shall not be less than three dollars nor more than six dollars per day of ten hours' actual field work, when a per diem compensation shall be established by the Secretary of the Interior instead of a per capita; nor, where the per capita rate is increased, shall it exceed three cents for each living inhabitant, twenty cents for each farm, and thirty cents for each establishment of productive industry; nor shall claims for mileage or traveling expenses be allowed any enumerator in either class of cases, except where difficulties are extreme, and then only when authority has been previously granted by the Superintendent of the Census. The allowance relative to inhabitants and deaths is the same as under the tenth census. There is an increase of a few cents in the compensation for enumerating farms and establishments or productive industry. It may not be possible nor wise to change this method, but it is possible and wise to make the compensation fair and just. Under these rates it is almost impossible for an enumerator to earn a fair day's wage if he does his duty. In localities where the population is dense, he can earn three or four dollars per day. His ambition is—and human nature prompts it—to secure as many names as possible, and in too many instances he will do this at the expense of accuracy; for accuracy consumes time. Furthermore, he may be inclined, in the very worst localities, in the slums of great cities, to omit, for personal reasons of convenience or otherwise, to enumerate all the people, being contented with taking the population in sight; in other words, two

cents a name might not induce him to enter all the dens of the slums of a great city for the sake of accuracy. In sparsely settled localities even three cents a name (the per capita rate, it must be borne in mind, covers all the multitude of facts called for on the population schedule) will not enable an enumerator to earn a living for the time employed, and he is often inclined to take the statements of neighbors rather than to travel a mile or two to secure accurate statements relative to half a dozen persons. In enumerating establishments of productive industry, the compensation allowed by law will not enable an enumerator, either honestly or dishonestly inclined, to secure any very valuable results. It is quite impossible to fill out a manufactures schedule completely and with fair accuracy for twenty cents. A man could not earn one dollar a day if he did his duty, and on the enumeration of farms he could not earn seventy-five cents a day. The complete agricultural statistics under the census of Massachusetts in 1885 cost about one dollar per farm, instead of fifteen or twenty cents.

The difficulty which Congress would have to meet in adjusting this matter of compensation is twofold. If a very large body of enumerators, like that employed under the elventh census, nearly fifty thousand, should be enlisted on a per diem compensation, the fear would be that there would be men enough in that vast army who would delay their work for the purpose of increasing their earnings to swell the cost of enumeration to enormous proportions, although reasonable accuracy would thereby be secured in every direction. On the per capita basis the question would be whether accuracy should be sacrificed for the sake of a lower cost. The evils of the present system are so great, however, so far as compensation is concerned, and the results of the census vitiated to so large a degree, that it would seem to be wise to adopt a system of compensation which should secure fair accuracy in the results, even at an increase in the expense The country grows so rapidly, and the wealth and business increase so largely, that the total expense of a census should not be considered when the accuracy of the same is at stake.

Another fault of the present system, to my mind, lies in the organization of the field forces. It is perfectly natural that the Census Office, and that Congress, even, should seek a speedy enumeration of the people; but it is submitted that if an instantaneous enumeration can not be had—and it is clearly demonstrable that it can not in this country—then whether it take a week or two weeks, or even three or four, to complete the enumeration becomes a matter of lesser consideration. It might, therefore, be wise to make larger districts and use a less number of enumerators rather than to extend the method by decreasing the size of the

districts and increasing the number of enumerators, as is the present tendency. An enumerator, working for a few days, acquires speed and accuracy as a matter of experience, and his second week's work is of vastly greater value than his first few days' service. It might be well, therefore, to so subdivide the country into enumeration districts that each enumerator would have at least four or five thousand people to enumerate, instead of an average of two thousand, as under the present method. If the districts were enlarged, the number of supervisors should be greatly increased. The present law provides for one hundred and seventy-five supervisors; that of 1880 provided for one hundred and fifty. It would seem to be a prudent measure to provide for at least one thousand supervisors, which body, with a reduced number of enumerators, could take greater pains with all parts of the enumeration; and if supervisors could be selected with special reference to their fitness and enumerators could be tested by the use of a preliminary schedule relating to their own families and perhaps one or two neighboring families, results would be secured which would defy criticism. With such changes there should come a change of date for the enumeration. The count of the people is now made as of the 1st of June—under the present law, the first Monday in June. The changes in the habits of the people necessitate a change of date. More and more every year people leave the town for the country, and this change occurs about the time of the enumeration. The date should be changed to a period of the year when the population is more thoroughly fixed or more thoroughly housed in permanent homes. Could the date be carried forward to the autumn, a great gain would be made in the accuracy of the enumeration—not perhaps in the total for the whole country, but in the total for each State and city. Certainly the results would be far more satisfactory to all concerned, even though the change in the total population of the United States did not exceed a few thousand. Each State wants its own: political and social reasons demand that this should be so.

Perhaps the very worst form of the present system is the temporary nature of the service. As the census year comes in sight each decade, a Census Office is created by law, the organization to be taken entirely from new material, from the head to the foot. Of course, the aim always is in securing a superintendent to select some one who has had more or less experience or is supposed to be more or less competent in census work; but then comes the greater difficulty, the selection of the forces. A good business man at the head of the Census Office—one of excellent administrative and executive abilities, without knowledge of statistics—would handle a census, in all probability, as well as or better

even than a statistician without business qualifications; but the organization demands skillful men at the head of divisions and skillful and trained statisticians as assistants. Every superintendent endeavors to draw into his service a certain number properly qualified, statistically speaking, for the service required; but everything must be drawn together hurriedly—a great bureau, the largest in the Federal Government, created in a brief period, and the work carried on with the greatest rapidity. With the vast expansion of census inquiries, in connection with the necessarily speedy organization, it is absurd, without regard to the qualifications of the head of the office, to expect valuable results for the money expended. It is not in the power of any superintendent, no matter what his experience, no matter what his qualifications may be, to take a very satisfactory census under the conditions involved in our Federal system. The attempt is made to create a vast official machine, and then to at once collect material involving in its collection answers to thousands of inquiries by a force of nearly fifty thousand men in the field and an office force of five thousand, the whole work to be completed within a year or two, and the data to be collected under a system of compensation which does not allow, or certainly does not induce, accurate work. The result is that the Census Office is, within a few months after the date set for enumeration, literally "snowed under" with raw material collected by crude and, in a large majority of cases, inefficient forces, to be digested and compiled for printing by another force nearly as crude as the field forces. It is not in the power of human capacity to carry out scientifically the work of the Federal census. It never has been done; it never can be done until the system is changed. This does not involve any criticism as to the growth of the system nor of the men who have so ably administered it. The point I make is that the census system has grown to be unwieldy in natural ways, and that it is time to correct it, and the very first step toward correction lies in the direction of the establishment of a permanent Census Office, under which there ought to be a constant force of trained and experienced statistical clerks, and the collection of facts distributed over the ten years instead of being crowded into a few months. This change of itself would correct many of the faults of the present system. The facts relating to population and agriculture might be collected in the fall of the census year, when the new agricultural crops would be considered instead of the old, as under the present system, and then the data relating to manufactures and all the other features necessarily involved in the census could be taken up year after year and carried each to a successful conclusion. This would involve the employment constantly of a much reduced office force, and a field force, except for the enumeration

of the population, gradually becoming more and more skillful. The expense during the whole ten years would be somewhat larger than is now involved, but the results would be of such infinitely greater value that the increased expense would not be a matter for a moment's consideration. My suggestion, then, for future census work would be, first, a permanent Census Office, involving an efficient field force, under the most liberal provisions as to supervision, and an organization of an office force so adjusted that it could be made elastic and yet preserve the functions required to secure accuracy and completeness; second, an adjustment of compensations for field work that would secure complete and accurate returns in all the departments of census work.

It may be argued that there would be nothing for a permanent Census Office to do a great part of the time. In answer to this it can be said, that if the regular work of the census should leave the force in comparative idleness, it might be employed in tabulating some of the results of previous censuses which it was found necessary to abandon; for instance, in 1880, although the facts were secured by the regular enumeration, no tabulation was made of the single, married, widowed, and divorced. The questions now agitating the public mind relative to marriage and divorce are only half discussed, because the facts for the whole country can not be ascertained. This is only one feature. A tabulation of the facts relative to conjugal condition, as indicated, for the year 1880 would be vastly more valuable, even now, than it would have been in 1880. And so of other features. By picking up such abandoned results, a reasonable force in the Census Office could be constantly and profitably employed, with increasing skill, so that when the results of new enumerations came into the Census Office, a trained force sufficiently large to influence the whole body of new appointees would be in readiness.

If, in addition to the changes suggested, the several States could be induced to co-operate with the Federal Government, a great advantage would be gained. The States might undertake the collection of the statistics of population, manufactures, and agriculture on as extended a basis as individually they might choose, but guaranteeing to furnish the Federal Government with certain clearly defined and uniformly collected data, for which the Federal Government should provide reasonable compensation. Under some such adjustment the statistical work of the United States Government and of the individual States could be brought to a very high state of perfection, with the burden of expense so divided and adjusted that it would not be considered as a stumbling-block in the way of progress.

One of the most encouraging movements of the present day is that of the trade and business organizations of the country to

secure a perfected and scientific statistical service in this country. This movement commenced during the closing days of the last Congress, through memorials from boards of trade, presented by the National Board of Trade, asking that the question of the establishment of a permanent Census Office be considered by the Secretary of the Interior and a report made to the Fifty-second Congress. The matter is therefore open for consideration by the public and by Congress, and, whether a permanent statistical service is provided for or not, great good must come from the discussion, and ultimately the faulty features of the present system be removed.

REEF-KNOT NETS.

By WILLIAM CHURCHILL.

AT the bottom of textile industries net-meshing appears to precede even such simple weaving as the making of mats of grass and bark. Not only is it the earliest of the textile arts, but it is even more prominently an unchanged art through all the stages of development which have culminated in the Jacquard loom. Ancient or modern, laboriously made by hand or the product of intricate machinery, the mesh knot is practically unmodified in the nets of the steam trawler and the naked savage. It seems, indeed, one of the few contrivances of human ingenuity which came early to perfection and have not proved susceptible of any improvement in all the succeeding ages.

It may, then, be not without interest to present a radical variant of the common mesh knot as noticed in general use among a considerable people in the western Pacific, together with such notes as are available to show a wider distribution of this knot.

In western New Britain, on the coast of Dampier Strait, facing New Guinea, where the Papuan characteristics are most strongly impressed upon the Melanesian type, the writer noticed the netting of a large seine and was attracted by the unfamiliar motions of the old women engaged in the work. Closer examination disclosed the fact that every knot in the mesh was of the sort known as the reef or square knot, in which the four ends come out in pairs, each pair on one side of the bight or loop of the other pair. As nothing could be more widely dissimilar from the ordinary mesh knot, an effort—and a successful one—was made to induce the netters to communicate their art, which is here presented with figures which may aid to a clear comprehension of the method of manufacture employed. These figures give a view of a net in process of construction, with detailed drawings of the foundation knot and of the successive stages in forming the mesh knot.

Besides the netting-cord (commonly *coir*, the fiber of the cocoanut husk, which is very durable in the water), the only tool used is the mesh-block (E, Fig. 4). This is a thin block of hard wood rasped into shape, and, since these tools are treasured as heirlooms, together with interminably long rhythmical recitals of the wonderful takes of fish made by nets fabricated on each block, the wood most commonly employed is the very dense and hard iron-wood (*Casuarina equisetifolia*). It is highly polished and usually ornamented upon the ends with property marks, showing the exogamous marriage class and *gens* of the owner, which here take the place occupied by tribal distinctions among the endogamous races. The blocks are commonly of uniform size. Their length, which is practically a constant quantity, is determined by the length (about five inches) which may be held between the extreme tips of the fingers and the ball of the thumb, for that is its position when in use and to secure it against slipping the edges are carefully brought to a true right angle. The height of the block is, of course, determined by the width of mesh desired, but a height about equal to the breadth of the hand across the palm is most frequent, since the mesh made upon that gauge is found most satisfactory in taking the fish usually seined for. In width the blocks seldom exceed a half-inch, and have an oval section. Smaller hand-nets, in which accurate meshing is not desired, are commonly knotted over the finger with much nicety.

The net is started on pegs driven into a beam, corresponding in number with the number of meshes in a tier which it is desired to put into the net, and these netting-beams are a prominent feature on every village green. At a distance from the end of the cord somewhat greater than the proposed width of the net, a bowline knot (A, Fig. 4) is turned in and cast upon the first peg toward the right. The two unequal parts of cord issuing from this knot may, for the sake of distinction, be denominated the ball part and the free part. The latter is carried taut to the second peg, and there stopped close to the beam by a light lashing, and at the top of the peg is passed into an eye or narrow cleft. The mesh-block is now laid against the row of pegs; the ball part is passed first below and then above it from the bowline knot to the second peg, forming the first half-mesh (B, Fig. 4); it is then cast over the second peg, and the free part of the cord attached thereto with a pair of half-hitches (C and D, Fig. 1). The free part is then withdrawn from the eye in the peg, drawn taut through the two half-hitches, and half-hitched back upon itself (E, Fig. 1). It is now carried from the knot just formed (C, Fig. 4) to the next peg and there made ready for further use; the ball part is again carried around the mesh-block and hitched and bound as before. Upon the last peg in the row this knot is made,

and in the remainder of the free part close to the peg there is turned in a second bowline knot (D, Fig. 4). These two bowline knots serve as clews to the net. This selvage and first tier of half-meshes are invariably made from right to left, on the ground that it is the custom of the country, and any variation therefrom would be attended by consequences as unpleasant as they are ill-defined.

The second tier of meshes is made from left to right, and here the peculiar mesh knot makes its first appearance.

Holding the mesh-block in her left hand, so that its upper edge just touches the bottom of the meshes already formed, the operator passes the ball of cord from the last knot down in front and up behind the mesh-block (F, Fig. 4), making due allowance for the difference in size of this exterior mesh necessary to keep the tier uniform. The ball is held in the right hand, gripped between the ball of the thumb, the palm, and the third and fourth fingers, thus leaving the thumb and two fingers free to work

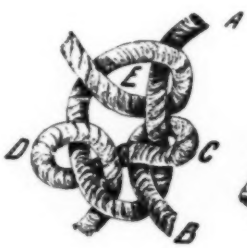

Fig. 1.—Selvage Knot.

Fig. 2.—Mesh Knot, first turn.

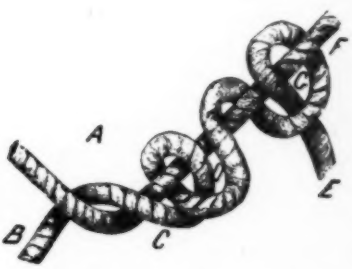

Fig. 3.—Mesh Knot, second turn.

with. A loop (C, Fig. 2) of any convenient size is made in the netting-cord, between the block and the ball, passed up through the bight of the mesh (A) from below, and drawn through the bight sufficiently far to draw taut the part which passes about the mesh-block, in which position it is stopped by the left thumb on the block. The ball (E) is passed through the loop (C), also from below upward (as shown at D), returned to its place in the palm of the right hand, and the part drawn taut and stopped by the left thumb. This completes a single turn of the knot as shown in Fig. 2, where the relation of the several parts is exhibited before they have been pulled taut and stopped, which in practice will be found essential to the success of the operation.

The second and final part of the knot is illustrated in Fig. 3. A second loop (F) is made in the cord between the ball and the part stoppered by the left thumb. This loop is passed from above downward through the bight of the mesh (A), drawn taut, and stopped at the mesh-block by the left thumb as before.

Through this loop (F) the ball (E) is passed also from above downward (as shown at G), and pulled taut to the left thumb, where the knot is felt to turn part way around, and is found to be a perfectly formed square knot as shown in Fig. 4, at G.

This second tier of meshes completed, the operator shifts the ball to the left hand and the mesh-block to the right, and makes the third tier from right to left. The final tier with its clews and selvage are made by reversing the process described for beginning the net.

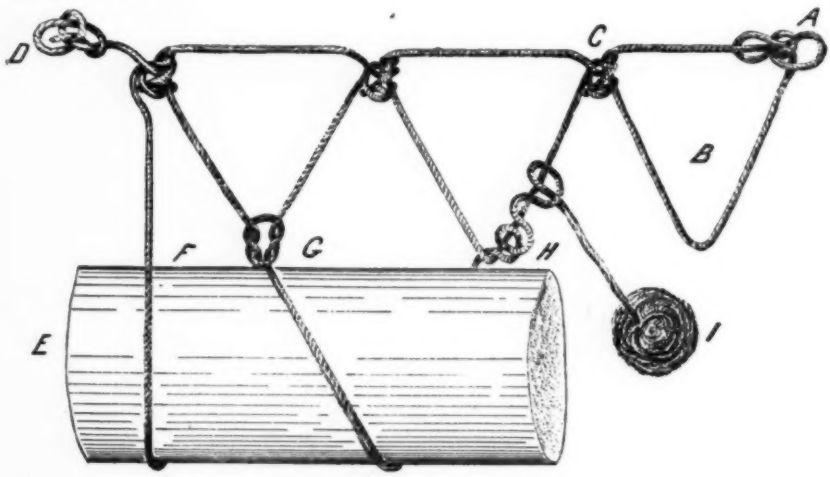

FIG. 4.

This method of meshing, though unfamiliar, has several distinct advantages over the more usual method; of which one inheres in the knot itself, two in the line of greater simplicity in the mode of manufacture, and one in the possibility of easily producing irregular designs for particular purposes—that is to say, of netting pockets and pounds without interruption of the thread.

The advantage in the knot is one which will immediately be apparent to those who have given attention to the study of knots, for the reef knot is incontestably the simplest and most secure means of joining two parts of cord. The advantages in the mode of manufacture are that one implement, the netting-needle, is dispensed with, and that the net may be made of a single cord continuous throughout, and thus is of equal strength in every part. It would be tedious to go into the details of making pounds and pockets in a net; it is more simple than appears, and the thread continues without a break through the net and insert-piece as well. It is possible that some one skilled in mechanical arts may find in this device the suggestion of a mode of simplifying the machinery at present used in the manufacture of nets for commercial purposes.

In connection with the several obscure but remarkable instances of correspondences between the American shores of the Pacific and the remoter islands of Melanesia, it is interesting to note that the only other well-defined discovery of this mesh was made in British America upon the Pacific shore. Prof. George Davidson, of San Francisco, a most accurate student of the life of the native races with whom he had to deal, in prosecuting the survey of that coast, found nets of this peculiar mesh manufactured by the Tchin-cha-au Indians of British Columbia in the vicinity of Port Simpson, and described it in the proceedings of the California Academy of Sciences, of which body he was for many years the president. The writer has been informed that a similar mesh has been noticed in the textile remains of the lacustrine period of Switzerland, but he has been unable to identify the reference in any of the figures contained in the usual authorities upon that prehistoric society.

THE ETHICS OF CONFUCIUS.

By WARREN G. BENTON.

IN former papers on the Chinese religions I referred to Confucianism as a religion, following the generally accepted view of the matter. But in this paper I shall treat it as in no legitimate sense a religion, but simply and purely a system of moral or ethical philosophy.

Religion has to do primarily with the existence of a deity and with the question of man's immortality, and the relationship existing between the two. Morality may grow out of man's effort to sustain an acceptable relationship to the Deity and the future life; but if so, it is incidental to and not a part of religion. The ages most noted for religious enthusiasm, and in which human life and liberty were most freely sacrificed for orthodoxy in religious opinions and forms, were notoriously immoral. And at the present day, in many countries, the most religious are not the most moral communities. At Panama, a few years ago, I went to a cockpit on a Sunday afternoon, and among the spectators were several gentlemen in clerical cloth; and after the various battles were ended I observed that these clerically clad gentlemen were exchanging coin on the result. During the same afternoon, while "taking in" the sights of that town of cathedrals and churches, I saw more than one woman, around whose neck was suspended an image of the Virgin Mary, but whose manner of life indicated that a less appropriate symbol could not well be imagined. It is equally significant that rarely does a criminal ascend the gallows

in this country that he is not accompanied by a clergyman, and he dies with the professions of piety and religious faith on his lips. Our penal institutions are filled with religious believers, and it is rare, in fact, that such men are not nominal members of churches, or at least have been at some time in their lives. I do not mention this fact to intimate that religious education or belief tends to promote immorality, for it does not; but rather to show that religious belief does not necessarily promote morality, no more than does the absence of such belief tend to promote immorality

If a system of ethics and morality founded upon a purely human basis, and having no reference to any deity or future life whatever, is a religion, then Confucianism is a religion. But I do not know of any definition of the term that would include such a system.

The simple assertion, by those claiming authority on a subject that lies beyond the sphere of demonstration or proof one way or the other, has either to be accepted as a fact or repudiated as not proved. In the realm of religious dogmas it has been held to be good logic that when a proposition can not be disproved that it stands as proved. By this logic religions have been established. But in the matter of ethics the case is different. This comes within the scope of experience and demonstration, and is the outgrowth of experiment. There is no absolute standard of morality, what is construed as such being a relative condition, and regarded as good or bad, according to the state of civilization and educational standard by which actions are measured. What is regarded as perfect conduct in one age or under one environment may be rightly condemned under a higher development of the moral sense as a feeble attempt at morality.

What is called conscience can not be set up as a guide in the matter, for it is but the result of the *mode* of education. One man's conscience will approve of a given course, when another under a better social and political education will repudiate it as vicious. Among the lower orders of savages and uncivilized men there is apparently no moral standard observed. With the lower animal kingdom questions of priority and individual rights are settled, not by any tribunal in equity, but by the measure of physical strength. And what are considered the cardinal points in moral and ethical systems, as set forth in the decalogue of the Jews and in the corresponding codes of other ancient religions, are but the embodiment of the results of experience in the earlier developments of civilization When men first began to acquire property by industry or cunning, they found it inconvenient to have others appropriate the results of such thrift, and perhaps the first moral obligation recognized was the right to property;

and the law against theft was among the first formulated codes: "Thou shalt not steal." Before such institutions as police courts were evolved, the only tribunal for adjusting personal difficulties was to fight it out; and the stronger combatant, other things being equal, was proved in the right because he vanquished his foe. But, as societies or community of interests began to be formed, it was found better to have boards of arbitration to settle disputes, and, as is shown in the controversy over the ownership of a certain herd of cattle in biblical times, the method of settling intricate problems partook largely of the plan of tossing up of pennies, yet it indicates that progress was being made over the fighting era. "Thou shalt not kill," especially a fellow-tribesman, was an early section of the moral code.

The custom of mating which obtains among many species of birds and some quadrupeds, and which, as man advanced in civilization, resulted in the establishment of the marriage relation, led to the edict against adultery. As tribes increased in numbers, it was found necessary for purposes of offensive and defensive warfare that some sort of organization should be observed, and this implied a division of labor and function. Political organization implied that some one or more of each tribe be designated to direct the operations of the rest, and the greatest warrior was naturally selected as the first chief; and the first chief used his power and position to install his sons as his successors, and thus were the first royal families evolved and succession to rulership established. National or tribal lines of jurisdiction followed the introduction of agricultural and breeding pursuits, and states and national boundaries were surveyed or designated. Territorial limits being established, tribunals or international bodies were necessary to regulate conflicting interests. The first resort was the war-club, and the enslavement of the vanquished. This method of arbitration has not yet been fully eliminated, but progress is being made in that direction, and international tribunals for arbitration now endeavor to supersede the sword.

Thus were governments evolved and written constitutions and statutes enacted, and codes of laws with penalties for restraining the criminal classes from violating the rules experience has found to be essential to good government and good society. None of these primary laws have been created by the makers of religions, but all such have found these in force wherever man has reached a sufficient degree of civilization to receive a religion.

This is why in all the various systems of religion we find the same essential basal moral laws inculcated. One has not copied from another, as is sometimes asserted. The fact that the same moral laws are found in two or more systems of religion does not indicate that the younger has copied the older, but that both ap-

propriated existing well-defined and primal elements of moral law which had been evolved in preceding ages.

Confucius followed this principle, and did not lay claim to having originated the principles of his philosophy, but to have simply undertaken to revive laws which the ancients had laid down, but which had become practically obsolete through non-observance. He undertook to induce his fellow-men to observe the essential laws of good government and good society, not because of attached penalties, but because it was necessary to good society and the promotion of virtue. He recognized with sorrow that political intrigue, infidelity to the trusts of men in all relations, and crime of all kinds prevailed in spite of the laws intended to regulate such things, and to the task of restoring the righteous rules of his ancestors he set himself. He knew that penal codes were powerless for good when there was not a moral sense to enforce them. Modern prohibitive legislation is a parallel case.

All the prohibitive statutes that our Legislatures have so far enacted have failed to do away with drunkenness, for the reason that there is lacking sufficient personal sense of obligation to enforce them. The Chinese statutes, or the writings of the fathers, the classics so called, set forth the means to virtue and morality; but neither the legal authorities nor the people recognized any need for enforcing or observing them. He sought by precept and example to revive the moral sense of the people; but at the end of a long life he died in poverty and disappointment, having apparently produced no impression.

Kung-fu-tse (Latinized into Confucius) was born about 550 B. C. His father was descended from one of the many royal families which had figured in the past as rulers of tribes or provinces. Most likely these ancient Chinese royal families were little more than the Indian chiefs in our day, and their claim to royalty was recognized only in a very narrow limit. But he was not in power when the Sage was born. He had been married two or three times, but had no son, except one cripple, which did not count. At an advanced old age he married a young wife, and Kung, Jr., was the result. The father died when the boy was about three years old, and left his family in poverty. But, under the class distinctions into which Chinese society was divided, Kung inherited at least the class instincts of a gentleman, and managed in some manner to obtain a good education as Chinese education went. He was married when about twenty years old, and soon after his marriage his mother died. According to the custom of his country, this event required that he retire for three years from all business relations, and it is supposed that he spent this period of mourning in the study of the classics. When he again

appeared in public he engaged in teaching school for some years; but, being imbued with the desire to effect a reformation among his people, he gave up teaching and sought and obtained employment in a government position under the ruler of his native province. His life as a civil officer enabled him to observe the methods of official conduct, and still further intensified his desire to restore a more righteous rule. He decided to seek the co-operation of some one of the many claimants to royal prerogative, and, by enlisting such sympathy, he calculated that by inaugurating a model reign, under whose influence men would turn again to the correct paths, he would absorb all contiguous provinces, unify the government of the race under a common flag, and see virtue and peace again among men. But he failed, after wandering from one province to another, to enlist the sympathy or co-operation of any one in a position to assist him; and he eventually gave up in despair, and, gathering a small following of disciples about him, he retired from public view, and passed the remainder of his days in teaching his chosen few and lamenting the evil days upon which his people had come. To fully appreciate the great task he had set out to accomplish, the reformation of China upon a strict ethical basis, it is necessary, as far as possible, to picture the condition of his people at that time. If we allow for some advance in civilization during the past twenty-five hundred years, and contemplate the China of our day with what in his day it must have been, we must concede that he had a very unpromising, crude material to work upon. From what he wrote on the condition of things, and also from the writings of Mencius a century later, we conclude that it was indeed a dark picture for the idealist to contemplate. Mencius states that in his time men had reached a state of degradation in which they denied that there was any distinction between good and evil, virtue and vice. All moral restraints were thrown off, and public or private morality was unknown. But, notwithstanding the philosopher was dead, his name and writings still existed, and had their influence on a few minds. Among these was Mencius, who seems to have been a more able man than Kung himself, and who espoused the cause of reform. He was wise enough to see that nothing might be hoped for in the way of co-operation of the rulers, who were as bad as the common people, but he set to work to gather and put into form the writings of Kung-fu-tse. Perhaps but for this work the very name of the Sage would long ago have been forgotten; for his writings were left in a fragmentary and scattered shape, and even do not take high rank in point of literary merit. The Confucian Analects, as compiled by Mencius, and with added comments by the latter, have been translated into English by Rev. Mr. Legge, an eminent Oriental scholar, and the

work comprises in many large volumes about all that is known of the writings of the Sage.

The bulk of this extensive work consists in obscure allusions to things no doubt familiar in his time, but now obsolete; and in meaningless fine distinctions and references to the "Rules," "Forms," and such things that have but little significance to the modern reader. But the gist of the matter may be summed up in one short sentence: "Walk in the old paths." And when we come to define the old paths we find what he called the "Five Relations," under which he defines every known duty of man. These "Relations" had been defined and enforced ages before, in the books called the Classics, perhaps for the reason that they were so old that no one knew when or by whom written. It is these five propositions that have called forth dozens of folio volumes to elucidate and enforce. And it is these that constitute what is known as Confucianism, although he never originated them nor claimed to be other than a teacher of the faith of the ancients.

These five relations have in them an entire code of political and social economy of the highest order.

First Relation; King and Subject.—Kung, in harmony with the established form of government under which he lived, was an advocate of absolute monarchy. The fact that he had a tinge of royal blood in his own body may have unconsciously influenced his judgment on this point. At all events, he left no indication of any disapproval of the system. He favored paternal government, both for the nation and in the family. The patriarchal plan has always been followed out in China to the fullest detail. The Emperor is as the father of the big family, and there is no appeal from his authority. The question of how the reigning monarch attained his position is not taken into consideration. The fact that he is on the throne is sufficient to secure the most absolute and abject obedience to his mandates. Kung set forth certain wholesome rules which should control his actions in the belief that the subject as well as the ruler had rights. He sought to supersede kingship by force with kingship by fitness. The civil government being a counterpart to the family government, the rules or principles obtaining in one should be equally applied in the other. The subject should love the king as the son loves the father, not for the enemies he might have made, but because of a righteous administration of the affairs of the country. He gave no countenance to a divided household. No rival political parties, appealing by bribes of office, nor threats of non-support at the next election, could disturb the serenity of the rulers or ruled. No penalties for treason, where a government was so good that none could find fault, were needed; and, in the event of individ-

ual remonstrance, the recalcitrant was to be dealt with as a father would treat a disobedient son. The rod has always been the chief instrument of enforcing discipline in the political household as well as the domestic household; and cases that will not submit to this primitive method of chastisement are visited with the guillotine.

The fact that no one could be found willing to undertake to put in force his method of conducting government is due to the strict conditions he sought to enforce. Rulers were accustomed to hold the people in check by force of arms, and subaltern petty officers were appointed by the crown and held their position by carrying out the desires of their creator. Confucius declared that political appointments in the civil service should be made on the basis of individual merit, rather than simply the standard of subservience to the dictation of the throne. He was the first advocate of civil-service reform, and his success in that line is not calculated to create very high hopes in those of our day who would substitute a similar test for office.

It is commonly understood in this country that China has long practiced competitive examinations of candidates for office. They do go through such a form, but it is a mere farce. For appointment to a position in the customs service, for example, the examination is conducted by testing the candidate in his proficiency with the bow and arrow, and by having recitations from memory of certain portions of the classics. The man who can hit the bull's-eye the greatest number of times in a given number of shots with the bow, and can recite the greatest number of pages from some book, of the meaning of which he may be utterly ignorant, is considered the best fitted for the position. It may be that they consider that a man who is skillful with the bow, and whose memory will absorb a long list of trite sayings in a book, will also be capable of acquiring useful knowledge in his chosen position in the civil or military service; but certainly the attainments tested are of no practical benefit in the work to be done. Running and jumping and other athletic attainments are also tested. This is more useful, especially in the military service, than the other tests appear to be. A good runner in the army may be an important foresight in the selection of soldiers or officers who are thus selected. China's experience in her recent wars with European armies has taught her the need of a fleet-footed soldiery to enable them to get out of the way of the enemy.

It is, of course, difficult to estimate what part the teachings of Confucianism have had in forming the national character of the Chinese. Some powerful influence must have been required to secure such a condition of contentment under such an arbitrary government to hold together in apparent submission to one reign-

ing house for so many centuries. True, that country has been the scene of many bloody civil conflicts in her history. At the time of Confucius the country was not, as now, one united empire, but was divided into many smaller jurisdictions. The political unity of China was brought about several centuries after his death, and was the result of a long period of tribal or provincial conflicts.

Then later the Tartars subjugated China, and absorbed the original China proper, as it is spoken of, into the present boundary, and the Tartar dynasty has held the control of the government ever since. The only attempt of any importance made since that conquest to restore Chinese rule was the Taiping rebellion. This revolt promised to be successful, until the British and French Governments interfered in aid of the Tartars, and under Chinese Gordon put down the rebellion. Now every precaution is taken to prevent another rebellion. Guns and gunpowder have been declared contraband, and are not permitted to the ownership of the natives.

The Chinese contingent in the army is equipped with bows and arrows, spears, and old-fashioned muzzle-loading blunderbusses of the most primitive pattern. All native regiments are also officered by Tartars, and Tartar regiments are equipped with modern rifles, and drilled under European tactics, to give them an advantage in the event of any future uprising.

Local magistrates and governors of provinces and districts are all appointed by the Emperor, from the Tartar contingent, and hold their offices at the discretion of the throne. They assume to judge of what is beneficial, and decide the policy of the Government entirely on their own judgment, without consulting the wishes of the populace. There is no appeal to the people for approval or disapproval of the Government's action on any subject. The masses submit to the inevitable, not apparently so much from any recognition of wisdom in its administration, but rather as an inevitable result of their inability to help themselves. Taxation is laid in a most summary and arbitrary manner, and collected by the officers appointed for that purpose, and there is a continual struggle between the tax-collectors and the tax-payers to try to outwit each other. Duty is assessed upon every article of domestic production, as well as all imports. Farm products have to pay duty at every thirty miles they may have to traverse to reach a market. A cargo of tea leaving Hankow for the seaboard for export, if carried in native bottoms, must pay taxes every thirty miles of the distance. Under treaty stipulations, cargo carried under foreign flags is assessed only at the point of departure. This has created a lucrative business for many Americans and others, who ostensibly buy boats and cargoes, and fly

the American flag over them, for a fee from the real owners. Merchants of all classes are taxed five per cent on gross sales, and have to submit their books for inspection freely to the tax-collectors; and detected efforts to get around the tax, other than by bribing the collectors, which is not at all difficult to do, results in the confiscation of their entire possessions. Once I witnessed the novel transaction of a foreigner who wanted to purchase a milch-cow, and the farmer drove the cow to the outside limits of the tax station on the outskirts of the town, and tied her there and came for the buyer to accompany him outside to complete the purchase. He could pass the cow without taxation, but the native owner could not. This is why the Chinese in California show such skill and fertility of resource in smuggling in opium. Their past training in subterfuges to beat their own tax-collectors has trained them in the business. And they do not regard it as any crime to beat the Government if they can. In this freak they are not wholly unlike many of our own race, as our custom-house officers are aware.

We can not, of course, determine what would have been the condition of China, in the matter of the relationship between ruled and rulers, had Confucianism never impressed its doctrines on the subject, but certainly he has not achieved any striking success in this first of the five relations.

SECOND RELATION: HUSBAND AND WIFE.—The husband is regarded as holding much the same relation to the wife as the Emperor to the people—that is, he has absolute authority over her. But that authority must be exercised with justice and sympathy. The wife shall obey the husband, but he must be worthy of obedience. Polygamy is now practiced in China, but it seems not to have been at the time of Confucius. At least I have observed no reference to the matter in his treatise on the second relation, which seems probable would be the case if it was recognized at the time he wrote. His plan elaborated the most minute provisions for the conduct of married people, and, were his ideal carried out, a most happy state of married life would result; but, judging from appearances, he has more signally failed on this point than on the first relation. Chinese marriages are not conducted on the plan most conducive to harmony. Their matches are not made in heaven, as poets sometimes declare of this matter, but in a broker's office. They are not the result of a personal courtship between the parties to the compact, but are a matter of barter and sale. Fathers negotiate for wives for their infant sons, and infant betrothals are in reality infant purchases. Both husband and wife being entirely passive in the matter, there can not be anything approaching to personal attachment between them. Marriage being a matter of purchase, there is no provision

for divorce required. If a husband is not pleased with the wife, he can sell or trade her off. If the wife is not satisfied, she can drown herself. The so-called slavery of women in Chinese communities in this country is simply the lawful marriage arrangement of that country. It sometimes transpires that women bought as wives are treated as merchandise, which they really are as a matter of fact, and are subjected to immoral and degrading uses. This is especially the case in this country, where the women are few in comparison to the number of men of that race. In China women are treated with perhaps as much consideration as in other countries. They are not accorded full recognition as the equal in rights with man, but there are those even in our own country who declare that this is true of our women also. In China they are not treated as being personally responsible for their position in society, and are guarded with a more jealous care than with us. Here, a wife or daughter, growing weary of the restraints of the home, may go to another city, change her name, and enter upon a life of entire freedom from all restraints with impunity. With them it is impossible. Women there sustain more the position of domestic animals, which have a material value, and, if they stray from home, some one is interested in looking after them, much as an estrayed horse or ox. It is a matter of fact that, from whatever cause, there is not to be found in Chinese cities the class of abandoned and immoral women as in all European and American cities. The laws of the land forbid them, and their laws are more strictly enforced in this regard than in any other country I know anything about. Polygamous marriages and the concubinage system prevail, however, and, while this may be as bad as the other, it is not so apparent and obtrusive upon the public notice as are the Whitechapels of London or New York. But, view it as one may, it is apparent that the condition of Chinese women is far from what Confucius thought it should be.

THIRD RELATION: PARENT AND CHILD.—In this relation the greatest stress is placed upon filial obedience. Under the patriarchal family economy, the eldest male living is the acknowledged head of every family, even though the family, as it often does, contains three and four generations. The father of the family is the established authority on all matters of policy in business and otherwise, yet each son owes special allegiance to his own father. Nor is this duty ended with the death of the father, but is perpetual. Once a year the grave must be visited and the little mound rebuilt and kept in repair by the dutiful son. The wine and food that are left by the grave in connection with this ceremony of rebuilding graves are not a part of Confucianism, but the point of contact with Taouism. This custom of

honoring the dead has created the impression among foreigners that the Chinese worship their dead. "Ancestral worship" is commonly spoken of as an established fact; but it is entirely a mistake. They do not worship their dead in any legitimate sense. The ceremony of restoring the graves is not unlike in nature and answers much the same sentiment as our annual ceremony of decorating the graves of our soldier dead. We strew flowers upon graves and construct monuments in marble or bronze over the tombs of our distinguished dead, and yet we do not worship them. If a Chinaman, witnessing these observances with us, wrote to his friends that the Americans worship their dead and erect idols over their tombs, it would be a similar error to that we perpetuate in our books regarding the Chinese ceremonies in honor of their dead. Ancestral tablets are hung upon the walls of Chinese homes much as painted portraits are upon ours, not to be worshiped, but to keep in perpetual memory the departed. The desire to be thus honored after death is why Chinamen are so anxious to leave sons. It is also why those dying in foreign lands are so careful to have their bones taken back to their native homes. They wish to be remembered when they are gone, and only sons—dutiful sons—will see that the graves of their fathers are kept green. It is the most striking feature of Chinese character—their great respect for their fathers. In all business enterprises, in poverty or in wealth, the Chinese look to their fathers for counsel and example. This amounts with them to a positive passion, and is the greatest obstacle in the way of the introduction of modern methods and appliances. What was good enough for their forefathers is good enough for them. If anything new is offered, they dismiss it with the belief that, if it had been necessary, their fathers would have had it. They are not an inventive people, and use to-day the same pattern of plow and hand-made goods of all sorts they did a thousand years ago. The same cut of coat, build of boats, architecture, everything remains now as it was at the time when history with them first began. Filial affection is deep-rooted in their natures, and no one questions the propriety of it. Here, at least, Kung has impressed himself upon his people.

FOURTH RELATION; BROTHER TO BROTHER.—The patriarchal plan of family government leaves but little scope for individuality in the members of a household. Estates are entailed from one generation to another intact. All the members of a family partake of the resources in common, and are supposed to perform their share of the labor. But they own nothing in severalty. This removes the most fruitful source of fratricidal conflict. No quarreling over division of property, and no cutting off of one in favor of another heir at law, for all remain in equal possession of

the property, and each subsists upon a common treasury. All the sons work in the same business, shop or store, with the father. This is why for a hundred generations the Chinese follow the same calling. A shoemaker's sons are shoemakers, for the reason that they are put to work at the bench as soon as they can drive a peg. Shifting from one employment to another is rare with them. They do not take freely to learning a new trade, because, if they have any property in the family, it can not be divided and sold by the heirs, unless the sale is by consent of all the heirs, and then, of course, a mutual distribution is made. In business pursuits, the profits of the enterprise are not drawn out by the members of the firm, which in almost all cases means the family; but, after meeting current expenses, the accrued surplus goes into the accumulated assets. Thus, unequal wealth is not a source of family quarrels. I never knew two brothers where one was poor and the other rich. They are all poor or rich together. The trait, thus developed, of intimacy between brothers and all members of the household has left its imprint upon Chinese character in general. Clannishness is one of their national marks.

FIFTH RELATION; MAN TO MAN.—In this proposition is the province of ethics. It is a far wider field for the philanthropist and reformer to deal with than any of the foregoing. Here all ties of kinship and fear of authority are removed, and the question of the equality and rights of man comes in. The same sentiments in our Constitution are lauded as the climax of humanity and civilization. The same sentiments were promulgated by a pagan philosopher five hundred years before the Christian era; and he founded his arguments upon what had been written so long before his time as to be ancient history.

Men have always been in each other's way Conflicting interests of tradesmen and fellow-workmen of the same crafts always have and always will exist. The harmonious co-operation of Bellamy will probably require more than twenty centuries to materialize. Labor unions seek to regulate the matter by restricting apprenticeships. Merchants try by underselling each other to drive the weaker ones to the wall. Manufacturers and capitalists enter into trusts, hoping to freeze out the smaller competitors and destroy competition. But all alike fail of their purpose, and conflicting interests as old as the human race itself continue, and always will, in all likelihood. In times past unwelcome competition was checked in a more violent manner. Walking delegates and boycott committees were armed with daggers and clubs, and the stronger tribes annihilated the weaker ones or enslaved them. It is certainly a high testimonial to the pagan reformer that he sought to inculcate the doctrine that one man had any rights that another was under obligations to respect.

The golden rule of the Christian religion is regarded as the climax of excellence. Five centuries before Christ, Confucius wrote page after page to inculcate this same principle. One half of the decalogue of Moses is devoted to enforce the rights of man between man. Thou shalt not steal, nor bear false witness against thy neighbor, nor covet anything that is his. One man shall not tear down or injure another, in order to promote his own interests, is a doctrine hostile to the nature and practices of men in all ages, and yet a principle essential to the perpetuity of governments and social progress. Animals by instinct devour and destroy each other in their pursuit of life. Men in uncivilized states do the same thing in effect; and it is quite clear that we have not yet fully outgrown the animal instinct in this direction. But we all understand that it is right to do so, and, if we do not, we at least pretend that we do, and only eat each other metaphorically.

Nature has wisely provided that, when a man has lived for a few years, he shall give place to his successors. But as long as one remains on the earth, other things being equal, he is entitled to life, liberty, and the pursuit of happiness in his own way, provided his way does not interfere with the rights of others. There is room on the earth for all that are likely to occupy it at any one time, and, when the numbers reach an excess, disease or famine or war relieves the surplus. And under all circumstances every man should be protected in his life and interests from unequal advantages being taken of him by his neighbors. So taught Confucius. So teach all systems of sound social and moral philosophy.

In conclusion, I wish to say that, judged by what it has probably accomplished, the Confucian system has done much toward creating whatever of good is found in Chinese character and institutions; and what it has failed to accomplish is not due to any defects in the system, but rather to the inherent tendency in human nature to seek its own way. Men have been slow to ask what is the better and wiser course to pursue, and have inclined to follow their more brutish instincts.

At the present day, however, Confucius wields but little influence over the Chinese. In most cities are temples, or, more correctly speaking, halls known as Confucian halls. They are entirely void of any appearance of idolatry. His name is revered as a wise and good man, but he is not worshiped, nor has he in any legitimate sense been deified by the people. As Washington in America is venerated as the father of his country, and as Abraham Lincoln is spoken of in history as the savior of his country, so likewise is Confucius spoken of among his people as the wise philosopher, and patron of letters, and promoter of good government, but not as the founder of a religion, nor an object to be

worshiped. Educated Chinamen all profess to be disciples of him and to read his works, and to be guided by his instructions. In some respects they perhaps do, but they put their own interpretation upon the import of his teachings. There are no special teachers to expound his works, and every one is free to place such construction upon his teachings as his intelligence or impulses may lead to.

I am convinced that the power of the philosopher over his people has been overestimated by foreigners generally, and that the real nature and scope of his work have been largely misapprehended.

THE ORIGIN OF PAINTING.

By M. LAZAR POPOFF.

IT is said repeatedly, as of course, that Egypt was the cradle of the arts. Yet archæologists like Lartet, Garrigue, Cristi, and others have shown that the first artistic manifestations go back to epochs far anterior to the ancient Egyptians. According to these authors, these first manifestations were contemporary with the presence of the reindeer in the south of France—when the mammoth had not yet quite disappeared, and when man, ignorant of the metals, made all his instruments of stone, bone, and wood. In fact, the first works of art, and particularly the first efforts at drawing, date from those prehistoric times. In France, the oldest remains of these works of art have been found, in the shape of drawings engraved with a flint point as ornaments on articles of reindeer-horn, in caves by the side of the fossil remains of animals which, like the mammoth, have since disappeared, or, like the reindeer, have abandoned those regions. Other drawings have been found on tablets of stone, horn, or mammoth-ivory.

It is not our intention to insist on the simply linear rudimentary designs of which these ornaments consist. We rather invite attention to more perfect and characteristic works, in which, according to the words of Carl Vogt, the spirit of observation and imitation of Nature, and especially of living Nature, is remarkably manifested. An image of a mammoth, found in the cave of La Magdelaine, in the Dordogne, is engraved on a tablet of mammoth-bone. Very striking are the ungainly attitude of the animal's massive body, its long hair, the form of its elevated skull, with concave forehead, and its enormous recurved tusks. All these traits, characteristic of this extinct type of pachyderm, are reproduced by the designer with a really artistic distinctness. The mammoth was already rare in Europe when this primitive artist lived; and this, perhaps, is the reason why only two of the numer-

ous designs found in the caves of France are of this animal.* The second of these drawings, found in La Lozère, represents a mammoth's head sculptured on a staff of command. The images of the chamois, bear, and ox are found more frequently; but figures of the reindeer are most numerous. Some are engraved on plates of bone, and others serve to ornament various objects. Sometimes groups of animals are represented, or, on the other hand, the animals are only partly drawn, and merely the head or head and chest are visible.

The larger part of these drawings do not excel in execution the figures which our school-boys make on walls; but the figures of the reindeer are generally superior on account of the remarkable care with which the characteristic lines of the animal are traced, and also, in examples that are otherwise very rare, by the addition of a few shadows. We conclude that the artist of the caves was particularly interested in the reindeer, which furnished his contemporaries with their principal food, as well as with clothing materials, arms for hunting, and household implements. We know, in fact, that the cave-dwellers lived on reindeer-meat, dressed themselves in its skin, made thread of its tendons, and cut their arrow-points from its bones. In other words, as the reindeer had not yet been domesticated, it stood to those primitive men as a valuable game, and the hunting of it occupied the larger part of their existence. We thus explain why that animal haunted the imagination of the artist of those times. The drawings of the chamois, the bear, and the ox were also often surprisingly exact and really valuable.

Besides these designs of mammals, there have been found in the caves of France a number of drawings of fishes, tolerably correct, but very uniform. According to Broca, they can all be referred to the salmon.

All these relics of the primitive arts of design prove abundantly that the men of that prehistoric age observed carefully the forms and attitudes of animals and were capable of representing them in an exact and elegant style, attesting, according to Broca, a real artistic sense.

Nothing like this has been observed in the reproduction of the human figure, and drawings of that kind are extremely rare. There are two such deserving mention, one of which represents a naked man, armed with a club and surrounded by animals; the second, a fishing scene, a man lancing a harpoon upon a marine animal—a fish according to Broca, a whale according to other authors. The whole of the design is puerile and out of shape, and

* Similar linear ornaments have been found in the caves in Belgium, and are referred by Dupont to the age of the mammoth.

the proportions are outrageously violated. This is not an exception, for the examination of all the drawings of this kind shows that skillful as were the men of those times in their drawings of animals, particularly of those which were important to them, they were bad delineators of the human figure. "I do not know," says Broca, "what prevented them from reaching perfection on this point, but the fact is indisputable and is certainly characteristic." Another no less characteristic point is the entire absence of designs representing plants. No design of a tree has been found, or of a bush or a flower, unless we regard as a flower the "three little rosettes" engraved on a handle of reindeer-horn, which some authors actually regard as a composite flower. This exclusive taste of the artists of the caves is evidently not accidental, for chance explains nothing; and we can not assume, with Carl Vogt, that primitive drawing originated in a general tendency of man toward imitation of living Nature. We believe that the object of these artistic productions was of a different character, and that they were intended, not for ornamentation of objects or for imitation pure and simple of Nature, but for the production of an instrument to be used in the struggle against Nature. We shall endeavor to substantiate this proposition in what follows, and shall have occasion to say something on the origin of painting in general.

We remark, first, that there is nothing to prove that the man of that time was intellectually superior to existing savages; and, if we observe these, we shall find that their drawings have usually a totally different significance from that which art has among civilized peoples; and that they have nothing in common with ornamentation and æsthetics in general. Indeed, numerous facts go to show that human thought, in the lower degrees of its development, distinguishes but poorly between subjective representations and objective reality, and that both give rise to the same ideas. For example, a savage seeing one of his family in a dream, can not imagine that the image is independent of the organic substance of the person in question; and he will see the same relation between the two as between a body and its image reflected by a surface of water. Thus the Basutos believe that if the shadow of a man is projected upon the water, the crocodiles will be able to seize the man himself. A like identification may be pushed to the point that tribes are known which use the same word for the soul, the image, and the shadow.

It is necessary to take this fact into consideration in order to appreciate the real sense of the primitive design, and to re-establish the conditions under which it originated. If we suppose a material relation between the image and the object as well as between the shadow and the object, it becomes evident that the

savage would comport himself similarly toward the image, the shadow, and the object. From his point of view the image and the object are in close relation, and an action upon one would operate in the same way upon the other. By this way of looking at things, as Sir John Lubbock says, the savage is convinced that an injury done to the image is inflicted upon the original; or, to use the words of Mr. Taylor, he thinks that by acting upon the copy he will reach the original. The evidences are many that demonstrate the importance attributed by savages to this mode of action on the original. Waitz relates, after Denghame, that in a tribe of western Africa it was dangerous to make a portrait of the natives, because they were afraid that by some kind of sorcery a part of their soul would pass into their image. Lubbock also speaks of the same fear as existing among savages; and the more like the portrait, the greater the danger to the original; for the more life there is in the copy, the less must be left in the person. One day, when some Indians were annoying Dr. Kane by their presence, he rid himself of them very quickly by telling them that he was going to make their portraits. Catlin tells a story, at once sober and comical, that when he was drawing the profile of a chief named Matochiga, the Indians around him seemed greatly moved, and asked him why he did not draw the other half of the chief's face. "Matochiga was never ashamed to look a white man square in the face." Matochiga had not till then seemed offended at the matter, but one of the Indians said to him sportively: "The Yankee knows that you are only half a man, and he has only drawn half of your face, because the other half is not worth anything." A bloody fight followed this explanation, and Matochiga was killed by a bullet which struck him in the side of the face that had not been drawn. A still more characteristic incident is communicated by M. Brouck concerning a Laplander who had come to visit him from motives of curiosity. He having drunk a glass of wine and seeming very much at ease, M. Brouck took his pencil and began drawing his portrait. All at once our subject's humor changed; he drew on his cap and started to run away. Explanations being had, the Laplander made the rash artist understand that, if he had let him copy his figure, the artist would have gained a dangerous influence over him.

Charlevoix said, in the last century, that the Illinois and Indians of some other tribes made little figures representing persons whose lives they wanted to shorten, and pierced them in the region of the heart. A custom still exists in Borneo that consists in making a figure in wax of the enemy whom one wishes to bewitch, and setting it before the fire to melt; it is assumed, according to Taylor, that the person aimed at is disorganized as fast as

his image disappears. The Peruvian sorcerers still proceed in the same way, except that their figures are made of rags. In the Indies, according to Dubois, they knead earth collected from a very salt place with hair or pieces of skin, and make a figure on the chest of which they write the name of an enemy, and then stab it with needles, or mutilate in some way, in the belief that the same harm will be suffered by the person represented.

Traces of this primitive superstition are also found among civilized people, for Grimn reports that in the eleventh century Jews were accused in Europe of having killed Bishop Ebergard by a sorcery of the kind. They were said to have made a figure of wax representing the bishop, hired a priest to baptize it, and put it into the fire. As soon as the wax was melted, the bishop was attacked by a mortal disease. The famous adventurer, Jacob, chief of the Pastorals, in the thirteenth century, seriously believed, as he says in his Demonology, that the devil taught men the art of making images of wax and clay, the destruction of which brought on the sickness and death of the persons they represented. It was a custom in the time of Catharine de' Medici to make such figures of wax, and melt them slowly before the fire or stab them with needles, in order to bring suffering to enemies. This operation was called putting a spell upon them. We may also mention the opinion of the earlier Christian writers, who believed, according to Draper, that painting and sculpture were interdicted in the Scriptures, and were consequently evil arts. It may be questioned if this opinion did not have its roots in the idea of primitive peoples that the art of drawing was an instrument of sorcery, by means of which one acquired the power to act upon a person. Mussulmans still have a horror of images, and the Koran forbids having one's portrait made and possessing any image at all.

We would not exhaust this evidence if we did not cite all the facts that go to prove that, in the mind of primitive man, it was sufficient to possess anything—a piece of the garment, hair, a bit of a nail—that had belonged to a person to have power to act upon him and do him harm. The belief in the efficacy of this means is still so strong among some backward peoples, that persons who have any reason to distrust others hide their clothes so that they shall not be robbed of any part of them. Others, when they cut their hair or nails, put the cut parts on the roofs of their houses or bury them in the ground. So peasants in some countries bury the teeth which they pull from themselves.

We should add, to complete the picture, that writing to the savage enjoys the same magic power as drawing. This is easily understood when we recollect that writing by figures preceded writing by letters or any conventional signs, and is still met

among some savage tribes. In these writings by figures, the fact that the man or animal represented is under the influence of an evil lot is indicated by an arrow directed from the mouth toward the heart. A sign of this kind is considered equivalent to a real possession of the animal or person represented.

We could hardly give more convincing proofs of the special significance attributed by the savage to drawing, regarded by him as an instrument of power over another; and while the examples which we have just brought together relate chiefly to man, we may assume logically that the same process—that is, a figured representation of animals—plays a like part in the struggle of the savage against his natural enemies. Other facts exist confirmatory of this hypothesis.

According to Mr. Tanner, the North American Indians, to assure success in their hunting expeditions, made rude drawings of the animal they were pursuing, and stabbed them in the region of the heart, under the conviction that they would thereby obtain power over the desired game. Taylor relates, according to an old observer among the Australians, that the natives, in one of their festival dances, construct a figure of the kangaroo with plants, in order that they may become masters of the real kangaroos of the forest. An Algonkin Indian, going out to kill an animal, hangs up a figure of it in his lodge; then, after giving it due warning, shoots an arrow at it. If the arrow hits, the animal will be killed. If a hunter, having touched a sorcerer's rod with his arrow, succeeded in hitting the track of the animal with the arrow, it would be stopped and held till the hunter could come up to it. The same object could be attained by drawing the figure of the animal on a piece of wood and addressing suitable prayers to the image.

Such was the function of drawing at its origin. An Indian song admirably explains this function, in the words "My drawing has made a god of me!" Faith could hardly be more vigorously expressed in the power of the art of drawing as an instrument by the aid of which primitive man obtained a supernatural power over his enemy or his game. Regarding the works of the cave men in the light of these facts, we perceive that the purpose that inspired them had few points in common with the sense of the beautiful or the tendency to imitation; and it is clear that if there existed in the mind of the primitive man a material relation between a being and its shadow or its image, that man thought that the same relation was preserved between the being and its image when transferred to any object whatever. The purpose to be reached was to possess the shadow of the coveted object, and the only means of accomplishing it was to fix upon something or another the silhouette of that shadow.

This, in our opinion, was the origin of drawing, and, consequently, of painting. It is worthy of remark that all works of this kind derived from the embryonic period of the arts of design betray the same lack of proportion and absence of symmetry characteristic of the silhouettes of shadows. The uniform impression given by the drawings is that they relate, not to the objects themselves, but to their shadows. It is further interesting to note that some contemporary savages, some Australians, for example, are still incapable of grasping the meaning of exact images, while they readily comprehend a crude, disproportioned drawing. Thus, to give them an idea of a man, you have to draw him with a very large head; a feature with which precisely corresponds a drawing representing a fisherman that has been found in a cave in France. He has a greatly reduced body, but his hand, armed with an enormous harpoon, is the hand of a giant.

In his struggle with surrounding Nature, a struggle of which he can not form an exact conception, primitive man had especial need to possess every means that could give him confidence in victory. In starting for the hunt he took with him, as the North American Indian does now, and as some players in our most civilized circles do under another form, the fetich that would insure success—that of an image of the animal to be killed. By engraving on the handle of his knife the image of a reindeer or some other animal, he did not think of ornamenting his weapon, but of exerting some magic power over his prey. And his belief in this mysterious power, by giving him boldness, energy, and sureness of movements, would often procure him success. Confidence does thus in all things. Just like the modern savage, the cave man would believe that the greater the resemblance between the image and the animal, the greater also would be the chance of acting upon the animal. Hence the care that was applied to the reproduction of the animals especially coveted and with which the contest would be hardest; and hence those perfect designs of the reindeer, that magnificent game of our ancestors.*

Very different are the characteristics of the drawings of human forms; and, to account for these differences, we should consider the fact that all the archæological data relative to the epoch of the reindeer testify that the disposition of the man of that age

* In this I differ from the students who find in some of these drawings evidence that the reindeer was a domesticated animal at that time. A representation of two reindeer has been found at Lozère, one of which wears what is regarded as a kind of halter. But the absence of fossil remains of dogs, without which domestication of the reindeer is impossible, pleads, as Carl Vogt remarks, against the existence of the domesticated reindeer. In my opinion, this supposed halter represents rather the emblematic line of which I have spoken, proceeding from the mouth to the heart, indicating the enchantment thrown at the animal by the hunter.

was pacific. Broca calls these men "peaceful hunters," and attributes a gentle character to them. He remarks that an examination of their arsenal very rarely brings out warlike arms, and that we can thus satisfy ourselves of their peaceful character. The Belgian archæologist, M. Dupont, observes that the cave-dwellers of his country had no idea of war. And, if we have a right to compare the existing savage with primitive man, we find that the Eskimo, who is nearest like him, is quiet and peaceful. The Eskimo whom Ross met on the shores of Baffin's Bay could not be made to understand what war is, and possessed no warlike weapons. While, then, we may believe that the cave men rarely raised their hands against one another, it nevertheless remains determined that they waged a bitter and relentless war against animals. Hence they rarely had occasion to exercise themselves in drawing the human form; and hence the imperfect character of their human images as compared with those of animals. As to the forms of plants, it may be remarked that the boreal flora of that epoch, not being at all threatening, could furnish little food for superstition; and no drawings of plants are found in the caves.

In short, the condition of the art of drawing with primitive man seems to be in complete harmony with the meaning which we have attributed to drawing itself, of its being inspired by belief in the existence of a material relation between a being and its image and in the possibility of acting on the first through the second. Consequently, the principle of painting can not be found in a natural tendency of primitive man to the artificial imitation of living Nature, but seems rather to be derived from the desire of subjecting that Nature to its needs, and of subjugating it. In the course of its progressive improvements, the art of drawing has gradually lost its primitive significance and original meaning, till it has become what it is now. It does not differ much, however, from what it was originally; for, while the primitive man expected to reach the living being in its image, it is still life which the civilized man seeks to-day in works of art.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

Dr. Peters, the African traveler, believes that the Waganda, or people of Uganda, are descended from the ancient Egyptians; and some color is apparently lent to his view by the burial of their kings in mounds, the custom of embalming, and the existence of ancient rock excavations. But the Waganda might have borrowed these things from their northern neighbors. Dr. Peters observes that they undoubtedly excel every other African nation in the development of their intelligence, and that, in contrast to all other negro tribes, they feel the need of progress. It is believed that in the oldest of the burial mounds are interred records of the dead sovereigns that will explain the origin of the race; but at present the Waganda will not allow a search to be made.

HIGH LIFE.

EVERYBODY knows mountain flowers are beautiful. As one rises up any minor height in the Alps or the Pyrenees, below snow-level, one notices at once the extraordinary brilliancy and richness of the blossoms one meets there. All Nature is dressed in its brightest robes. Great belts of blue gentian hang like a zone on the mountain slopes; masses of yellow globe-flower star the upland pastures, nodding heads of soldanella lurk low among the rugged bowlders by the glacier's side. No lowland blossoms have such vividness of coloring, or grow in such conspicuous patches. To strike the eye from afar, to attract and allure at a distance, is the great aim and end in life of the Alpine flora.

Now, why are Alpine plants so anxious to be seen of men and angels? Why do they flaunt their golden glories so openly before the world, instead of shrinking in modest reserve beneath their own green leaves, like the Puritan primrose and the retiring violet? The answer is, Because of the extreme rarity of the mountain air. It's the barometer that does it. At first sight, I will readily admit, this explanation seems as fanciful as the traditional connection between Goodwin Sands and Tenterden Steeple. But, like the amateur stories in country papers, it is "founded on fact," for all that. (Imagine, by the way, a tale founded entirely on fiction! How charmingly aërial!) By a roundabout road, through varying chains of cause and effect, the rarity of the air does really account in the long run for the beauty and conspicuousness of the mountain flowers.

For bees, the common go-betweens of the loves of the plants, cease to range about a thousand or fifteen hundred feet below snow-level. And why? Because it's too cold for them? Oh, dear, no; on sunny days in early English spring, when the thermometer does'nt rise above freezing in the shade, you will see both the honey-bees and the great black bumble as busy as their conventional character demands of them among the golden cups of the first timid crocuses. Give the bee sunshine, indeed, with a temperature just about freezing-point, and he'll flit about joyously on his communistic errand. But bees, one must remember, have heavy bodies and relatively small wings: in the rarefied air of mountain heights they can't manage to support themselves in the most literal sense. Hence their place in these high stations of the world is taken by the gay and airy butterflies, which have lighter bodies and a much bigger expanse of wing-area to buoy them up. In the valleys and plains the bee competes at an advantage with the butterflies for all the sweets of life, but in this broad subglacial

belt on the mountain-sides, the butterflies in turn have things all their own way. They flit about like monarchs of all they survey, without a rival in the world to dispute their supremacy.

And how does the preponderance of butterflies in the upper regions of the air affect the color and brilliancy of the flowers? Simply thus: Bees, as we are all aware on the authority of the great Dr. Watts, are industrious creatures which employ each shining hour (well-chosen epithet, "shining") for the good of the community, and to the best purpose. The bee, in fact, is the *bon bourgeois* of the insect world: he attends strictly to business, loses no time in wild or reckless excursions, and flies by the straightest path from flower to flower of the same species with mathematical precision. Moreover, he is careful, cautious, observant, and steady-going—a model business man, in fact, of sound middle-class morals and sober middle-class intelligence. No flitting for him, no coquetting, no fickleness. Therefore, the flowers that have adapted themselves to his needs, and that depend upon him mainly or solely for fertilization, waste no unnecessary material on those big, flaunting colored posters which we human observers know as petals. They have, for the most part, simple blue or purple flowers, tubular in shape and, individually, inconspicuous in hue; and they are oftenest arranged in long spikes of blossom to avoid wasting the time of their winged Mr. Bultitudes. So long as they are just bright enough to catch the bee's eye a few yards away, they are certain to receive a visit in due season from that industrious and persistent commercial traveler. Having a circle of good customers upon whom they can depend with certainty for fertilization, they have no need to waste any large proportion of their substance upon expensive advertisements or gaudy petals.

It is just the opposite with butterflies. Those gay and irrepressible creatures, the fashionable and frivolous element in the insect world, gad about from flower to flower over great distances at once, and think much more of sunning themselves and of attracting their fellows than of attention to business. And the reason is obvious, if one considers for a moment the difference in the political and domestic economy of the two opposed groups. For the honey-bees are neuters, sexless purveyors of the hive, with no interest on earth save the storing of honey for the common benefit of the phalanstery to which they belong. But the butterflies are full-fledged males and females, on the hunt through the world for suitable partners: they think far less of feeding than of displaying their charms; a little honey to support them during their flight is all they need: "For the bee, a long round of ceaseless toil; for me," says the gay butterfly, "a short life and a merry one." Mr. Harold Skimpole needed only "music, sun-

shine, a few grapes." The butterflies are of his kind. The high mountain zone is for them a true ball-room; the flowers are light refreshments laid out in the vestibule. Their real business in life is not to gorge and lay by, but to coquette and display themselves and find fitting partners.

So while the bees with their honey-bags, like the financier with his money-bags, are storing up profit for the composite community, the butterfly, on the contrary, lays himself out for an agreeable flutter, and sips nectar where he will, over large areas of country. He flies rather high, flaunting his wings in the sun, because he wants to show himself off in all his airy beauty; and when he spies a bed of bright flowers afar off on the sun-smitten slopes, he sails off toward them lazily, like a grand signior who amuses himself. No regular plodding through a monotonous spike of plain little bells for him; what he wants is brilliant color, bold advertisement, good honey, and plenty of it. He doesn't care to search. Who wants his favors must make himself conspicuous.

Now, plants are good shopkeepers; they lay themselves out strictly to attract their customers. Hence the character of the flowers on this beeless belt of mountain-side is entirely determined by the character of the butterfly fertilizers. Only those plants which laid themselves out from time immemorial to suit the butterflies, in other words, have succeeded in the long run in the struggle for existence. So the butterfly-plants of the butterfly-zone are all strictly adapted to butterfly tastes and butterfly fancies. They are, for the most part, individually large and brilliantly colored; they have lots of honey, often stored at the base of a deep and open bell which the long proboscis of the insect can easily penetrate; and they habitually grow close together in broad belts or patches, so that the color of each re-enforces and aids the color of the others. It is this cumulative habit that accounts for the marked flower-bed or jam-tart character which everybody must have noticed in the high Alpine flora.

Aristocracies usually pride themselves on their antiquity; and the high life of the mountains is undeniably ancient. The plants and animals of the butterfly-zone belong to a special group which appears everywhere in Europe and America about the limit of snow, whether northward or upward. For example, I was pleased to note near the summit of Mount Washington (the highest peak in New Hampshire) that a large number of the flowers belonged to species well known on the open plains of Lapland and Finland. The plants of the High Alps are found also, as a rule, not only on the High Pyrenees, the Carpathians, the Scotch Grampians, and the Norwegian fjelds, but also round the Arctic Circle in Europe and America. They reappear at long distances where suitable

conditions recur; they follow the snow-line as the snow-line recedes ever in summer higher north toward the pole or higher vertically toward the mountain summits. And this bespeaks in one way to the reasoning mind a very ancient ancestry. It shows they date back to a very old and cold epoch.

Let me give a single instance which strikingly illustrates the general principle. Near the top of Mount Washington, as aforesaid, lives to this day a little colony of very cold-loving and mountainous butterflies, which never descend below a couple of thousand feet from the wind-swept summit. Except just there, there are no more of their sort anywhere about; and as far as the butterflies themselves are aware, no others of their species exist on earth; they never have seen a single one of their kind, save of their own little colony. One might compare them with the Pitcairn Islanders in the South Seas—an isolated group of English origin, cut off by a vast distance from all their congeners in Europe or America. But if you go north some eight or nine hundred miles from New Hampshire to Labrador, at a certain point the same butterfly reappears, and spreads northward toward the pole in great abundance. Now, how did this little colony of chilly insects get separated from the main body and islanded, as it were, on a remote mountain-top in far warmer New Hampshire?

The answer is, they were stranded there at the end of the Glacial epoch.

A couple of hundred thousand years ago, or thereabouts—don't let us haggle, I beg of you, over a few casual centuries—the whole of northern Europe and America was covered from end to end, as everybody knows, by a sheet of solid ice, like the one which Frithiof Nansen crossed from sea to sea on his own account in Greenland. For many thousand years, with occasional warmer spells, that vast ice-sheet brooded, silent and grim, over the face of the two continents. Life was extinct as far south as the latitude of New York and London. No plant or animal survived the general freezing. Not a creature broke the monotony of that endless glacial desert. At last, as the celestial cycle came round in due season, fresh conditions supervened. Warmer weather set in, and the ice began to melt. Then the plants and animals of the subglacial district were pushed slowly northward by the warmth after the retreating ice-cap. As time went on, the climate of the plains got too hot to hold them. The summer was too much for the glacial types to endure. They remained only on the highest mountain-peaks or close to the southern limit of eternal snow. In this way, every isolated range in either continent has its own little colony of arctic or glacial plants and animals, which still survive by themselves, unaffected by inter-

course with their unknown and unsuspected fellow-creatures elsewhere.

Not only has the Glacial epoch left these organic traces of its existence, however; in some parts of New Hampshire where the glaciers were unusually thick and deep, fragments of the primeval ice itself still remain on the spots where they were originally stranded. Among the shady glens of the White Mountains there occur here and there great masses of ancient ice, the unmelted remnant of primeval glaciers; and one of these is so large that an artificial cave has been cleverly excavated in it, as an attraction for tourists, by the canny Yankee proprietor. Elsewhere the old ice-blocks are buried under the *débris* of moraine-stuff and alluvium, and are only accidentally discovered by the sinking of what are locally known as ice-wells. No existing conditions can account for the formation of such solid rocks of ice at such a depth in the soil. They are essentially glacier-like in origin and character; they result from the pressure of snow into a crystalline mass in a mountain valley; and they must have remained there unmelted ever since the close of the Glacial epoch, which, by Dr. Croll's calculations, must most probably have ceased to plague our earth some eighty thousand years ago. Modern America, however, has no respect for antiquity; and it is at present engaged in using up this palæocrystic deposit—this belated storehouse of prehistoric ice—in the manufacture of gin slings and brandy cocktails.

As one scales a mountain of moderate height—say seven or eight thousand feet—in a temperate climate, one is sure to be struck by the gradual diminution as one goes in the size of the trees, till at last they tail off into mere shrubs and bushes. This diminution—an old commonplace of tourists—is a marked characteristic of mountain plants, and it depends, of course, in the main upon the effect of cold, and of the wind in winter. Cold, however, is by far the more potent factor of the two, though it is the least often insisted upon; and this can be seen in a moment by any one who remembers that trees shade off in just the self-same manner near the southern limit of permanent snow in the arctic regions. And the way the cold acts is simply this: it nips off the young buds in spring in exposed situations, as the chilly sea-breeze does with coast plants, which, as we commonly but incorrectly say, are "blown sideways" from seaward.

Of course, the lower down one gets, and the nearer to the soil, the warmer the layer of air becomes, both because there is greater radiation and because one can secure a little more shelter.. So, very far north, and very near the snow-line on mountains, you always find the vegetation runs low and stunted. It takes advantage of every crack, every cranny in the rocks, every sunny little

nook, every jutting point or wee promontory of shelter. And as the mountain plants have been accustomed for ages to the strenuous conditions of such cold and wind-swept situations, they have ended, of course, by adapting themselves to that station in life to which it has pleased the powers that be to call them. They grow quite naturally low and stumpy and rosette-shaped; they are compact of form and very hard of fiber; they present no surface of resistance to the wind in any way; rounded and boss-like, they seldom rise above the level of the rocks and stones whose interstices they occupy. It is this combination of characters that makes mountain plants such favorites with florists; for they possess of themselves that close-grown habit and that rich profusion of clustered flowers which it is the grand object of the gardener by artificial selection to produce and encourage.

When one talks of "the limit of trees" on a mountain-side, however, it must be remembered that the phrase is used in a strictly human or Pickwickian sense, and that it is only the size, not the type, of the vegetation that is really in question. For trees exist even on the highest hill-tops; only they have accommodated themselves to the exigencies of the situation. Smaller and ever smaller species have been developed by natural selection to suit the peculiarities of these inclement spots. Take, for example, the willow and poplar group. Nobody would deny that a weeping willow by an English river, or a Lombardy poplar in an Italian avenue, was as much of a true tree as an oak or a chestnut. But as one mounts toward the bare and wind-swept mountain heights one finds that the willows begin to grow downward gradually. The "netted willow" of the Alps and Pyrenees, which shelters itself under the lee of little jutting rocks, attains a height of only a few inches; while the "herbaceous willow," common on all very high mountains in western Europe, is a tiny, creeping weed, which nobody would ever take for a forest tree by origin at all, unless he happened to see it in the catkin-bearing stage, when its true nature and history would become at once apparent to him.

Yet this little herb-like willow, one of the most northerly and hardy of European plants, is a true tree at heart none the less for all that. Soft and succulent as it looks in branch and leaf, you may yet count on it sometimes as many rings of annual growth as on a lordly Scotch fir tree. But where? Why, underground. For see how cunning it is, this little stunted descendant of proud forest lords: hard-pressed by Nature, it has learned to make the best of its difficult and precarious position. It has a woody trunk at core, like all other trees; but this trunk never appears above the level of the soil: it creeps and roots underground in tortuous zigzags between the crags and bowlders that lie strewn through

its thin sheet of upland leaf-mold. By this simple plan the willow manages to get protection in winter, on the same principle as when we human gardeners lay down the stems of vines; only the willow remains laid down all the year and always. But in summer it sends up its short-lived herbaceous branches, covered with tiny green leaves, and ending at last in a single silky catkin. Yet between the great weeping willow and this last degraded mountain representative of the same primitive type, you can trace in Europe alone at least a dozen distinct intermediate forms, all well marked in their differences, and all progressively dwarfed by long stress of unfavorable conditions.

From the combination of such unfavorable conditions in arctic countries and under the snow-line of mountains there results a curious fact, already hinted at above, that the coldest floras are also, from the purely human point of view, the most beautiful. Not, of course, the most luxuriant: for lush richness of foliage and "breadth of tropic shade" (to quote a noble lord) one must go, as every one knows, to the equatorial regions. But, contrary to the common opinion, the tropics, hoary shams, are not remarkable for the abundance or beauty of their flowers. Quite otherwise, indeed: an unrelieved green strikes the key-note of equatorial forests. This is my own experience, and it is borne out (which is far more important) by Mr. Alfred Russel Wallace, who has seen a wider range of the untouched tropics, in all four hemispheres—northern, southern, eastern, western—than any other man, I suppose, that ever lived on this planet. And Mr. Wallace is firm in his conviction that the tropics in this respect are a complete fraud. Bright flowers are there quite conspicuously absent. It is rather in the cold and less favored regions of the world that one must look for fine floral displays and bright masses of color. Close up to the snow-line the wealth of flowers is always the greatest.

In order to understand this apparent paradox one must remember that the highest type of flowers, from the point of view of organization, is not at the same time by any means the most beautiful. On the contrary, plants with very little special adaptation to any particular insect, like the water-lilies and the poppies, are obliged to flaunt forth in very brilliant hues and to run to very large sizes in order to attract the attention of a great number of visitors, one or other of whom may casually fertilize them; while plants with very special adaptations, like the sage and mint group, or the little English orchids, are so cunningly arranged that they can not fail of fertilization at the very first visit, which of course enables them to a great extent to dispense with the aid of big or brilliant petals. So that, where the struggle for life is fiercest and adaptation most perfect, the flora will on the whole

be not most, but least, conspicuous in the matter of very handsome flowers.

Now, the struggle for life is fiercest, and the wealth of Nature is greatest, one need hardly say, in tropical climates. There alone do we find every inch of soil "encumbered by its waste fertility," as Comus puts it; weighed down by luxuriant growth of tree, shrub, herb, creeper. There alone do lizards lurk in every hole; beetles dwell manifold in every cranny; butterflies flock thick in every grove; bees, ants, and flies swarm by myriads on every sun-smitten hillside. Accordingly, in the tropics, adaptation reaches its highest point; and tangled richness, not beauty of color, becomes the dominant note of the equatorial forests. Now and then, to be sure, as you wander through Brazilian or Malayan woods, you may light upon some bright tree clad in scarlet bloom, or some glorious orchid drooping pendent from a bough with long sprays of beauty; but such sights are infrequent. Green, and green, and ever green again—that is the general feeling of the equatorial forest; as different as possible from the rich mosaic of a high alp in early June, or a Scotch hillside deep in golden gorse and purple heather in broad August sunshine.

In very cold countries, on the other hand, though the conditions are severe, the struggle for existence is not really so hard, because, in one word, there are fewer competitors. The field is less occupied; life is less rich, less varied, less self-strangling. And, therefore, specialization has not gone nearly so far in cold latitudes or altitudes. Lower and simpler types everywhere occupy the soil; mosses, matted flowers, small beetles, dwarf butterflies. Nature is less luxuriant, yet in some ways more beautiful. As we rise on the mountains the forest trees disappear, and with them the forest beasts, from bears to squirrels; a low, wind-swept vegetation succeeds, very poor in species, and stunted in growth, but making a floor of rich flowers almost unknown elsewhere. The humble butterflies and beetles of the chillier elevation produce in the result more beautiful bloom than the highly developed honey-seekers of the richer and warmer lowlands. Luxuriance is atoned for by a Turkey carpet of floral magnificence.

How, then, has the world at large fallen into the pardonable error of believing tropical nature to be so rich in coloring, and circumpolar nature to be so dingy and unlovable? Simply thus, I believe. The tropics embrace the largest land areas in the world, and are richer by a thousand times in species of plants and animals than all the rest of the earth in a lump put together. That richness necessarily results from the fierceness of the competition. Now, among this enormous mass of tropical plants it naturally happens that some have finer flowers than any temperate species; while as to the animals and birds, they are undoubtedly, on the

whole, both larger and handsomer than the fauna of colder climates. But in the general aspect of tropical nature an occasional bright flower or brilliant parrot counts for very little among the mass of lush green which surrounds and conceals it. On the other hand, in our museums and conservatories we sedulously pick out the rarest and most beautiful of these rare and beautiful species, and we isolate them completely from their natural surroundings. The consequence is that the untraveled mind regards the tropics mentally as a sort of perpetual replica of the hot-houses at Kew, superimposed on the best of Mr. Bull's orchid shows. As a matter of fact, people who know the hot world well can tell you that the average tropical woodland is much more like the dark shade of Box Hill or the deepest glades of the Black Forest. For really fine floral display in the mass, all at once, you must go, not to Ceylon, Sumatra, Jamaica, but to the far north of Canada, the Bernese Oberland, the moors of Inverness-shire, the North Cape of Norway. Flowers are loveliest where the climate is coldest; forests are greenest, most luxuriant, least blossoming, where the conditions of life are richest, warmest, fiercest. In one word, High Life is always poor but beautiful.—*Cornhill Magazine.*

SKETCH OF JAMES CURTIS BOOTH.

THE life of Prof. Booth is divided by Mr. Patterson Dubois, in his memorial address, into three periods: that of his preparatory student life, or the formative period, which closed in 1835–'36; the creative period, so named "because it called into being a method of technical education which has, probably more than anything else, resulted in establishing chemistry as a factor in commerce, and in gaining for the chemist a recognized place in the economy of the world's work," 1836 to 1849; and the period of his official life as melter and refiner at the United States Mint in Philadelphia.

JAMES CURTIS BOOTH was born in Philadelphia, July 28, 1810, the son of George Booth, of New Castle, Del., and Ann Balton, of Chestertown, Md.; and died in Philadelphia, March 21, 1888. He was taught in Philadelphia, at the seminary in Hartsville, Pa., and at the University of Pennsylvania, whence he was graduated in 1829. He then spent a year at the Rensselaer Polytechnic Institute at Troy, N. Y. He had a decided preference for the study of chemistry, of which he very early realized the capabilities and the practical value. Seeking opportunities and facilities for the performance of laboratory work in connection with his studies which America could not afford, he went to Europe

for them, and was the first American student who visited Germany for that purpose. He spent the year 1833 in Wöhler's private laboratory in Cassel; then practiced for nine months in the laboratory of Prof. Gustav Magnus, in Berlin; and employed the rest of three years abroad in attending lectures in Berlin and Vienna, and in visiting manufacturing establishments on the Continent and in England.

Having returned home, Mr. Booth established, in 1836, a student's laboratory—"the parent of all our existing laboratories for students in applied chemistry"—and became a teacher. "But it was no part of Mr. Booth's idea," Mr. Dubois says, "to make the laboratory course usurp the rightful position of the text-book and the lecture. He saw the great want of a supplementer rather than a supplanter. How truly he discerned what the scientific as well as the commercial world required, and how fully he met that requirement, needs no explanation here. The student's laboratories all over the country—if not beyond—as well as the throng of students who have come into and gone from his own laboratory during the past half-century—all attest the foresight, the judgment, the energy of a scientist and a business man."

In 1836 Mr. Booth was appointed Professor of Chemistry applied to the Fine Arts, in the Franklin Institute. In this capacity he delivered, between 1836 and 1845, three courses of lectures, of three seasons to each course. From 1842 to 1845 he was also Professor of Chemistry in the Central High School of Philadelphia. He interested himself in mineralogy and geology, and engaged in the Geological Surveys of Pennsylvania and Delaware, concerning which Prof. J. P. Lesley has written: "Prof. Booth and John Frazer, then a young man, were appointed by Prof. Rogers, in the spring of 1836, his two assistants in prosecuting the work of the first Geological Survey of Pennsylvania. From spring to fall they traveled along the Susquehanna and Juniata Valleys, blocking out the order of the great formations. Prof. Booth was sent by Prof. Rogers up the Potomac to make a section which could be compared with the Juniata section; and, when these three met at Huntingdon, he announced, to the astonishment of Mr. Rogers, that the mountains which fill the middle belt of Pennsylvania were made by two separate formations, now known as No. IV and No. X. Mr. Rogers was unwilling to accept this conclusion, and instructed Mr. Frazer to go to the Huntingdon Bedford line and make a cross-section from the Broad-Top coal down to the limestone of Morrison's Cove. At the end of the week the three met again in Huntingdon, and Mr. Frazer confirmed the statement of Prof. Booth. Mr. Rogers was still dissatisfied, and then went himself to repeat the section made by Mr. Frazer, finding it correct, and then accepting Prof. Booth's

Potomac section. Thus the grand column of our Palæozoic formations was established, and the credit of it is due to Prof. Booth. . . . Both Prof. Rogers's assistants resigned at the end of the year; and Mr. Booth was then appointed immediately, or not long thereafter, State Geologist of Delaware. His work in Delaware was published in his report, an octavo volume, now so rare that it is impossible to obtain a copy. My belief is that Prof. Booth abandoned field work very early in his career, and devoted himself to his chemical laboratory. At all events he is known in science altogether as an accomplished chemist, with a great reputation for diligence and accuracy, especially in the field of mineral analysis." The Delaware survey was under Prof. Booth's charge in the years 1837–'38; and a summary of the results to which it led was published in the Annual Report of the Survey in 1839, and in a memoir on the subject in 1841.

The act providing for the geological survey of Delaware required that an equal portion of the appropriation should be expended in each county. But the several counties did not all need the same attention. The geologist, however, was expected to spend an equal portion of his time in each county. He improved the time, when the geological work did not demand the whole of it, by traversing different parts of the counties, and imparting to the people such knowledge relative to agriculture as lay within the sphere of his information; and he embodied agricultural essays in his report. Pertinently to this instance of a characteristic weakness of law-makers, Prof. Booth remarked in his report on the unwisdom of allowing local interests to sway so much in legislation, when more could be gained in the long run by taking broader views. Believing that the wealth of the people could be promoted by their employing their own resources, however limited, he directed much time to the development of such as deposits of shells and decomposed organic matter, glass-making materials, potter's clay, iron, and copperas.

In explanation of the admission of theoretical matter into the report, when the work was designed to possess a practical character, he said: "In all probability the number of those who may peruse these pages is large, and their attainments are of a varied nature; some being purely practical men, others again having made considerable attainments in literature and science; and hence it was deemed advisable to adapt the memoir to the various demands of the community. . . . I am well aware of an opinion, too generally prevalent among men devoted to practical pursuits, that an attention to theories is rather prejudicial than otherwise to the successful pursuit of business. Whatever grounds they may have for such views, they are not valid when applied in a general way to theoretic investigations; for, independently of

other proofs of the incorrectness of their conclusions, it may be shown that many valuable practical results have either originated with or were improved by theorists, by those who have experimented with a view to establishing, maintaining, or refuting. Now, in regard to agriculture, it may be observed that it had already made considerable advancement when it began to assume a scientific form; but from that period to the present, by deriving assistance from other sciences, and particularly from chemistry, its progress toward perfection has been constant and rapid."

Prof. Booth's attention was drawn to the subject of refining cobalt, concerning which little or nothing was known outside of the commercial refineries, by the ill-success of an experiment in mining the metal which was begun in 1845. It was at the Mine La Mott, in Missouri, where he mined a large amount of cobalt, which was sent to England. It was returned as impure; whereupon Prof. Booth at once set to work to discover the best method of refining the metal—and succeeded.

Of Prof. Booth's qualities as an instructor Dr. Alexander Mucklé, a pupil of his, as also of Wöhler and Bunsen, and afterward his assistant at the Mint, is quoted as saying: "With this experience of teachers and means of comparison, I can say that Mr. Booth had few if any superiors as a teacher of practical chemistry; that he kept abreast of the times by constantly securing the best and latest scientific books and periodicals. A high value was placed upon a course in his laboratory, which soon became widely known and in great repute as a place for learning chemistry; and his teachings are believed to have had a potent influence in developing and disseminating the knowledge of the science and its practical applications."

Prof. Booth was appointed Melter and Refiner of the Mint by President Taylor in 1849, and entered that service on December 10th of that year. The time corresponded closely with the discovery of gold in California. The influx of gold from that source, already heavy, increased rapidly, and added greatly to the work of his office, while the quality of the metal increased considerably the difficulty of dealing with it. The new gold was alloyed with silver in excess of the amount admissible in the coinage, and this had to be extracted. The provisions of the Mint, which had been adapted for the treatment of the bullion which had been previously sent there, were not suitable to the refinement of this gold. New methods had to be adopted, and the whole plan of the parting apparatus had to be reconstructed. It was Prof. Booth's duty to make this adjustment. The process already known in the laboratories had to be expanded and used on a manufacturing scale. "To this work, as well as to all the other labors of his department," says Mr. Robert Patterson, Mr. Booth "brought the full knowledge of

theory and practice derived from former professional experience, and further showed, what is not always the case with chemists, a capacity to apply his knowledge in the larger way required for commercial results." There was delay at first in disposing of the gold that came to the Mint, and some impatience on the part of consignors, but the capacity of the Mint was soon enlarged to meet promptly every demand. In the course of five years the pressure of gold at the Philadelphia office was relieved by the creation of a Government Assay Office in New York and a Branch Mint at San Francisco. Then came a change in the standard of silver coin, causing an immense recoinage in small pieces; and then the issue, in place of the old copper cents, of copper-nickel pieces, and, after these, of bronze; each calling for other processes of assay and involving additional work.

An improved process for refining gold was described by Prof. Booth, in a letter to the Wastage Commission, as follows: "I refine usually to 993 and 995 m., and sometimes, to make a finer gold, I heat the alloy of gold and silver with parting acid, so as to nearly separate them, and then heat the residue with oil of vitriol and saltpeter, at a steam-heat, by which I have brought the gold to 998 m. The process is my own, and not known outside of the Mint." A paragraph from an article in the Journal of the American Chemical Society for June, 1885, on The Smelting Furnace of the United States Mint, is quoted by Mr. Dubois as characteristic. "My last improvement," Prof. Booth says, "which is still practiced, consists in the very simple operation of melting all the iron residues from the furnaces, even including grate-bars, and keeping them in a quiet melted state, so as to allow the heavier gold and silver to settle out of the iron. When the mass is cold, the precious metal is knocked off the bottom by a hammer as a single tough king, with scarcely a trace of iron in it, while the iron mass above it has never yielded a trace of gold or silver to the assayer. Instead of spending three weeks of annual vacation from melting in hammering tons of accumulated iron, we now melt through the year, whenever convenient, from five to fifty pounds of iron residues at a time. We gathered in one melting, last autumn, a cake of a few ounces of gold and silver from a mass of over fifty pounds of iron in a part of a day, and the latter was entirely free from the precious metals. When I first succeeded with this process, I could hardly believe in the perfect separation from iron, and the late Mr. J. R. Eckfeldt, the best assayer in the United States, doubted it, until, by numerous tests made from a piece of some thirty pounds of iron, he found a total absence of gold and silver."

The difficulties met at the Mint in adapting processes to the various kinds of metallic impurity that came in with the gold

and silver, and the responsibility of managing so large amounts, for which he was accountable in law to the full value, weighed heavily and constantly on his mind, and told severely upon his physical constitution, and, according to Mr Dubois, in his later years a painful anxiety "seemed to be ineradicably seared into his very life." His noticeable failure is traced by Mr. Dubois from the great "wastages" of 1872, together with subsequent difficulties in the recoinage of seventeen millions of our gold coin in 1873. Prof. Booth himself wrote upon this subject in a private letter in October, 1887: "The whole truth is that the constantly increasing business of the Mint beyond its own capacity for bullion storage has been increasingly weighing down my anxious thoughts for its safety, and you may add to that the consciousness that I was personally responsible for every ounce of bullion received, and then you will readily perceive sufficient ground for a constant anxious care, which I sometimes imagined to be as the square or cube of the extra quantity of bullion constantly poured in. . . . It was that constant and constantly augmenting ounce-for-ounce responsibility that finally affected my mind, and I rather think broke me down. I went home quite sick from the Mint early in April, and lay on my back for about three months. I suppose that such a statement will be quite sufficient to explain my present position. I am glad to say that I had sufficient strength to resign from my place in the Mint" (he resigned in August, 1887, after thirty-nine years of service), "although no one is yet appointed to take my place. However, I do not go more than once a week to the Mint, and shall be glad when the string of union is severed. . . . From my age, over seventy-seven, I hardly expect restoration of full strength, and am satisfied with what Providence designs." His successor was not appointed when he died.

Prof. Booth had a variety of side-pursuits, and was especially fond of linguistic studies, among which he took a particular interest in phonetics, short-hand writing, and the reform of English orthography. He regarded phonography as important in elementary education, and thought it should be required as an essential branch. Having mastered Pitman's Phonography, he perceived the defective character of the text-books on the subject, and himself published an elementary work upon it in 1849—the Phonographic Instructor. The Instructor was republished, with a key, in 1850 and in 1856. The book was a successful one.

Most of Prof. Booth's writings bore upon the special field of his studies and his work. Having become a member of the American Philosophical Society in 1839, he, in connection with Prof. Martin H. Boyé, communicated to the eighth volume of its transactions, new series, a paper on the Conversion of Benzoic Acid into Hippuric Acid. A considerable number of the reports of

the Franklin Institute Committee on Science and the Arts were of his writing. In co-operation with Campbell Morfit he prepared a report on Recent Improvements in the Chemical Arts, which was published by the Smithsonian Institution in 1852. The conservative, practical spirit that presided over the composition of this work is illustrated in the preface, where the authors say: "We have freely exercised discrimination in the selection of subjects, and have omitted much that we found in applied chemistry, because novel views need, in many cases, further confirmation to render them reliable in practice, and, if presented too early to the artisan, may be productive of more evil than good. We have kept in view the benefit of the practical man, the manufacturer or worker, and, while we have not avoided scientific terms where they were more convenient, we have generally used words of description intelligible to every one. We have confined ourselves to such foreign improvements in the chemical arts, whether patented or not, as we believed the American artisan might avail himself of, frequently offering critical remarks on them, and sometimes pointing out where improvements were likely to be made."

In the Journal of the American Chemical Society are papers on some methods of toughening gold and silver (September, 1884): A General Method of toughening Gold and Silver in the Melting Crucible (June, 1884); and The Smelting Furnace of the U. S. Mint (June, 1885), from which we have quoted. Other papers, the media of publication of which are not given by Mr. Dubois, are: On Beet-root Sugars (1842); Chrome Iron Analysis (1842); Constitution of Glycerin and Oily Acids (1848); and a Report on the Water-supply of Philadelphia (1862). His most conspicuous effort in literature was the Encyclopædia of Chemistry published in Philadelphia in 1850, which was written chiefly by him, but on the last half of which Dr. Campbell Morfit assisted.

Prof. Booth received the degree of LL. D. from the University of Lewisburg in 1867, and that of Ph. D. from the Rensselaer Polytechnic Institute in 1884. He was made a member of the Pennsylvania Horticultural Society in 1842; of the Philadelphia Academy of Natural Sciences in 1852; of the Maryland Institute for the Promotion of the Mechanic Arts in 1853; of the Philadelphia Society for Promoting Agriculture about 1859; and of the Historical Society of Pennsylvania in 1884. He was President of the American Chemical Society in 1883 and 1884, and declined reelection for a third term; and was interested in the diocesan work of the Protestant Episcopal Church and in various philanthropies. He is described as having been personally a gentleman of refined manners, pleasing address, and a cheerful disposition, which was often obscured, however, by his nervous intensity.

EDITOR'S TABLE.

UNIVERSITY EXTENSION.

THE article by Prof. C. Hanford Henderson on University Extension, which appears in the present number of the Monthly, is one which deserves and doubtless will receive a wide and sympathetic attention. Prof. Henderson states his case well, and no intelligent reader can fail to be impressed with the importance of the movement which he describes and advocates. For our own part we think its importance can hardly be over-estimated. It aims at nothing less than an intellectual revolution—at placing within the reach of thousands in every part of the country educational advantages which hitherto have been confined to university students. Useful as the colleges and universities are in their way, we incline to the opinion that what is known as university extension holds out a promise of yet greater usefulness. The former are often spoken of as "seats" of learning, and the expression is appropriate; but, in the extension movement, learning leaves its seats and goes forth to find its disciples in the highways and byways. This simple fact is a pledge of a more living adaptation to the practical needs of the community than is to be expected in the case of the older and more permanent educational establishments. The reactive effect upon the colleges themselves will doubtless be also very beneficial. The theory of the movement is that college professors will do extra-collegiate work; and it is certain that, in addressing more miscellaneous audiences than are wont to be gathered within college walls, they will learn new methods of instruction and discover new springs of influence. College students form a more or less select class, and they are expected not only to follow in an unquestioning manner the lines of study indicated to them, but to accept in the same way whatever may be the special educational views or traditions of the institution they attend. The extension classes will be at once more fluid in their composition and more favorable to initiative and originality on the part of the teacher. There will thus tend to be developed a new type of teaching and new conceptions of the possibilities of intellectual growth. Science will learn—what it has never yet thoroughly learned—to dwell among the people and mingle its life with theirs.

Taking another point of view, we might dwell upon the great need that exists for something that will bring home a touch of true culture and of exact knowledge not so much to the "masses" as to the "classes." Among the latter the fields are "white to the harvest." We are often told that the ignorance of the working classes is a source of danger to the state, but we are by no means persuaded that the ignorance of a somewhat higher social stratum is not a more serious danger. A couple of years ago the most popular clergyman in the United States, addressing his own congregation, recommended those of his hearers who were wealthy to spend their money freely upon every form of expensive luxury—to clothe themselves in the richest fabrics and most expensive furs, to ornament themselves with the costliest jewels, to make their houses gorgeous with everything that was most sumptuous and elegant, to feed themselves with splendid liberality, to conduct themselves in general—so he actually said—as God's favored children, for whom nothing could possibly be too good. In olden times it was said that the poor had the gospel preached to them, and that they heard it

gladly; to-day good news of a slightly different tenor comes to the rich, and how sweet it must be to be told that, being rich, you are presumably a favored child of God, and that in living a life of luxury that might make Dives turn green with envy you are simply carrying out his fatherly designs! But the eloquent preacher told his wealthy hearers more: he assured them that, in thus heaping indulgences upon themselves, they were helping the poor by furnishing them with employment. Of course he believed it, because the whole class to which he belongs, with only here and there an exception, believes it; and that is just where we see the great need for the missionary work of the university-extension system. Here are thousands of high-feeding, richly dressed, gospel-taught people, who, in matters economic, are sitting in the outer darkness of ignorance—silly enough to think that the more they consume on their pleasures the more benefit they confer on the world, the more they lighten the toil of the poor.

But it is not upon economic subjects only that the talk of the so-called educated classes betrays a woful lack of information and of coherent thought. Upon scientific and historical subjects it is much the same. By this time the main axioms connected with the doctrine of the conservation of energy ought to be the common property of all decently educated persons, but we constantly hear well-dressed people talking as if electricity, for example, were a mysterious something derived from a mysterious nothing, and thus constituted a boundless source of energy to be had for the asking. It is needless, however, to multiply examples: the world, in spite of all our educational institutions and perhaps a little through their fault, is full of ignorance in places where one would think ignorance ought not to be; and we may well, therefore, hail with joy the introduction of a scheme which seems likely to bring light and knowledge to many thousands of minds.

Upon one point, however, we find ourselves unable to agree with our contributor. After making out a strong case for the usefulness of university extension, he is disposed to draw the conclusion that the national Government should take it under its protection and sustain it by subsidies. From our point of view this would tend to mar the whole scheme. Its success will depend mainly on the individual zeal and public spirit with which it is conducted; but if there is anything that is fatal to zeal and public spirit, it is a subsidy. What is the cause of the paralyzing lack of vitality in our public schools if it is not that they are part and parcel of a political system? It may be granted at once that a national subsidy would greatly accelerate the movement; but we are convinced that what would be gained in rate of growth would be more than offset by deterioration in the ethical and intellectual quality of the work done. If people do not get knowledge to-day it is not for lack of pecuniary means; it is because they prefer to spend the means they might apply to the purpose to less worthy objects. If there is one feature more than another of the university-extension movement that awakens our interest and commands our sympathy, it is that it offers an opportunity for a true crusade against ignorance and folly. But the crusader and the subsidy-seeker are very different persons. The former may be mistaken, but he is enthusiastic; the latter is rarely mistaken, but his enthusiasm is of a low quality. Now, as we have said, here is a grand opportunity for a crusade—an opportunity to show that those who possess the keys of knowledge are willing to unload their stores for others, and that those who have means in abundance are willing to contribute freely to raise the intellectual and moral standard of society. All the elements of a great movement are present if only we can count on enthusiasm—on some small share of that feeling for duty and that

regard for others which bring Salvationists into the streets with their drums and tambourines. But the opportunity would be thrown away, and the movement would assume a thoroughly commonplace and almost mercenary character, if it were to be fed with the proceeds of taxation. We trust that the leaders of the movement will resolve to have nothing to do with politics save to purify and elevate them by the direct action of sound instruction on the public mind. It will not help our politics a bit to have university extension hanging round the Capitol for an appropriation.

A GROUP OF SCIENTIFIC MEETINGS.

THE meeting of the American Association was held this year in the midst of the meetings, beginning August 11th and closing September 1st, of a number of societies cultivating special fields of science, which have grown up out of and around it. The multiplication and division of societies in this way is a natural result of the increasing expansion and specialization of scientific studies in the United States, and one of the most certain signs of them. The fields which one society was able to cultivate have become too large and too many to be adequately tilled by it alone, and it has been found convenient to distribute the details among separate workers, while the old Association remains the central organization and chief, under which the whole is unified. This grouping of meetings promises to be a permanent feature, and to make our annual scientific convention an event of larger and growing interest. The meetings held in advance of the larger meeting were those of the American Microscopical Society, the Society of Official Chemists, the Association of Agricultural Colleges, the Society for the Promotion of Agriculture, a body which is limited to forty members; and the Association of Economic Entomologists. The discussions in these assumed, to a large extent, a practical shape, and aimed directly or indirectly at the advancement of agricultural interests. Among the important features of the meetings were the arrangements that were made for the fusion of the chemical societies of the United States into a single body. Eight societies were represented in the Union, viz.: The American Chemical Society, the Washington Chemical Society, the Association of Official Chemists, the Chemical Societies of Cincinnati, the Brooklyn Institute, the Franklin Institute, the Association of Manufacturing Chemists, and the Louisiana Association of Sugar Chemists. Under the terms of union, which have yet to be approved by the societies separately, the new organization will be called the American Chemical Society, and each local society will retain its identity as a branch. The name of the general society is the best that could be chosen for a body representing the whole country, and gives, besides, a fitting recognition to the oldest and one of the most efficient and active of our chemical associations.

The meeting of the American Association itself was one of the largest and best that have been held in recent years. The number of members reached 653, and was greater than had been recorded since the New York meeting of 1887, when 729 members were registered. Three hundred and seventy-one new members were elected, and 235 papers were entered to be read. Permanent Secretary Putnam has been quoted as saying that the papers read were above the average in interest and importance, and this opinion appears to be well founded. Among the subjects informally talked of as things to which the Association should give the support of its approval and influence were those of the establishment of a fund for the encouragement of scientific research, which was supported by Prof. Brashears and President Prescott; the with-

drawal of certain public timber lands from entry and their protection as forest reserves; and the utilization of the Weather Bureau and the agricultural experiment stations in forming a service of water statistics and the survey of water-supplies to serve as a basis for the application of proper principles of water management. On the invitation of the Australasian Association representatives were appointed to serve on an International Committee to prepare a uniform system of biological nomenclature.

The meeting of the American Association was immediately followed by that of the American Geological Society, which was followed in its turn by that of the International Geological Congress. The former meeting also took on somewhat of an international character, for several of the European geologists were present, and such of them as chose to take part in the proceedings were given the first places. The meeting of the International Congress was the fifth of the triennial series, and was attended by about two hundred members, nearly half of whom were foreigners from Austria, Belgium, Chili, France, Mexico, Peru, Roumania, Russia, Switzerland, Canada. Germany, Great Britain, and Sweden. Profs. James D. Dana and James Hall were designated honorary presidents of this body and Prof. J. S. Newberry president; but he not being able to attend on account of age, the sessions were presided over by one or another of the vice-presidents, Prof. Joseph Leconte presiding at the opening session. The Congress was welcomed by Secretary Noble, in a happily phrased address, in which he spoke of the importance of geology in its scientific and economical aspects, the activity with which its study is pursued in the United States, and the liberality with which it is assisted by the Government. The meetings were varied by the usual number of excursions, ending in a grand excursion of the International Geologists to the Yellowstone Park, the mining districts, the Colorado Cañon, and other points of geological interest in the West.

THE American Association has selected Rochester, N. Y., as the place for its meeting of 1892, and the following officers have been chosen for that occasion:

President, Prof. Joseph Le Conte, Berkeley, Cal.; permanent secretary, Prof. F. W. Putnam, Cambridge, Mass.; general secretary, Prof. Amos W. Butler, Brookville, Ind.; council secretary, Prof. T. H. Norton, Cincinnati, Ohio; treasurer, William Lilly, Mauch Chunk, Pa.

Vice-presidents of sections: A, Prof. J. R. Eastman, Washington, D. C.; B, Prof. B. F. Thomas, Columbus, Ohio; C, Dr. Alfred Springer, Cincinnati, Ohio; D, Prof. J. B. Johnson, St. Louis, Mo.; E, Prof. H. S. Williams, Ithaca, N. Y.; F, Prof. S. H. Gage, Ithaca, N. Y.; H, W. H. Holmes, Washington, D. C.; I, Prof. S. Dana Horton, Pomeroy, Ohio.

Secretaries of sections: A, Prof. Winslow Upton, Providence, R. I.; B, Prof. Browne Ayres, New Orleans, La.; C, Prof. J. L. Howe, Louisville, Ky.; D, Prof. O. H. Landreth, Nashville, Tenn.; E, Prof. R. D. Salisbury, Madison, Wis.; F, Prof. B. D. Halsted, New Brunswick, N. J.; H, Dr. Stewart Culin, Philadelphia, Pa.; I, Lester F. Ward, Washington, D. C.

Auditors: Dr. H. Wheatland, Salem, Mass.; Thomas Meehan, Germantown, Pa.

LITERARY NOTICES.

THE QUESTION OF COPYRIGHT. By GEORGE HAVEN PUTNAM. New York: G. P. Putnam's Sons. Pp. 412.

THIS convenient and timely book contains a summary of the copyright laws at present in force in the chief countries of the world, together with a report of the legislation now pending in Great Britain, a sketch of the contest in the United States, from 1837 to 1891, in behalf of international copyright, and certain papers on the development of the conception of literary property, and on the probable effects of the new American law. To the author's view, the American act of the present year, providing copyright for aliens, can hardly be accepted

as final legislation, and will doubtless at some no distant date call for further consideration as to some of its provisions. It leaves us still, in recognition of the claims of literary workers, very much behind the other nations of the civilized world. The result of fifty-three years of effort, it brings this country to the point reached by France in 1810, and by Great Britain and the states of Germany in 1836–'37. Under the provisions of the Berne Convention of 1887—which probably represents the final stage of international copyright in Europe—by fulfilling the requirements of their domestic copyright laws, authors can now at once secure, without further conditions or formalities, copyright for their productions in all the states belonging to the International Union. This union comprises nearly all the countries of Europe, with Tunis, Liberia, and Hayti. "It is not probable," says Mr. Putnam, "that another half-century of effort will be required to bring public opinion in the American Republic up to the standard of international justice already attained by Tunis, Liberia, and Hayti."

THE PRISON QUESTION. By CHARLES A. REEVE. Chicago: A. C. McClurg & Co. Pp. 194. Price, $2.

THIS book gives a theoretical and philosophical review of matters relating to crime, punishment, prisons, and reformation of convicts; considers mental, social, and political conditions as they bear upon these things; and presents the author's views about the causes and the prevention of crime and the production of criminals. We do not have to accept the author's views specifically to recognize that he has thought carefully and deeply on the subject, and has reasoned upon it without undue prejudice. The fundamental principles of the book were first presented by him in a public lecture, about twelve years ago, and have been urged in various papers read before the National Prison Congress. The purpose of the book is to group some important well-established facts and apply them to the subjects of prisons and reforms, in such order as will interest so much of the general public as can be reached, and so aid in creating a public opinion that can intelligently and practically deal with and dispose of the defective classes and the causes that produce them. The author believes that an impractical theology on the one hand, and a blind agnosticism on the other, alike operate to prevent a true solution of the problems of criminality. From a false position no step can be taken in advance without plunging into falsities. The only practical steps are such as lead to a true position. These the author tries to point out, by studying the criminal's mind and the factors that operate upon it—among which are physical and mental energy, theology, natural forces, marriage, society, and other surrounding influences—as they tend to develop, restrain, perpetuate, or procreate criminal tendencies. A very important place is given to heredity, and, by consequence, to such regulation of marriage as will best prevent the transmission of criminal appetites. The relations of government, legislation, punishment, and prisons to the criminal are considered; reformation receives a hopeful word; but the measures to which real importance is attached are those that appertain to prevention.

THE STURGEONS AND STURGEON INDUSTRIES OF THE EASTERN COAST OF THE UNITED STATES, WITH AN ACCOUNT OF EXPERIMENTS BEARING UPON STURGEON-CULTURE. By JOHN A. RYDER. Washington: Government Printing-Office. Pp. 50, with Plates.

THE studies embodied in this monograph were made by the author in the spring of 1888 at Delaware City, Del., a very important center of the sturgeon-fishery. Notwithstanding the results of the effort were in some respects unsatisfactory, a number of novel facts were collected and experiments were carried out which must be of great significance in any further attempts at the artificial propagation of these fishes. The embryological data have been drawn partly from the author's own experiments and partly from the work of other authors. The embryos of the common sturgeon here illustrated are believed to be the first of that species that were ever figured. The important fact was determined that the common sturgeon (*Acipenser sturio*) is the only species which is at the present time of commercial value in the fishery of the Delaware. A few specimens of *Acipenser brevirostris* were obtained—a species which has not been

certainly recognized since Le Sueur's time. The only profitable fishery of the common sturgeon—unless the Florida sturgeon should prove to be of the same form—is on the eastern coast of the Delaware River and Bay. A considerable amount of capital is invested in the business. The experience of the dealers and fishermen shows that a steady falling off has occurred in the catch within a few years. This and other facts prove that it is high time that something was being done to stay the extinction of the fish. The only means of maintaining and increasing the industry is through artificial propagation; and the author has every reason to think that this may be successfully accomplished at a comparatively insignificant outlay.

THE DISEASES OF PERSONALITY. By TH. RIBOT. Chicago: Open Court Publishing Company. Pp. 157. Price, 75 cents.

THE idea of personality is easily handled by metaphysicians who assume an ego. The school of experimental psychology, however, which claims M. Ribot, views this as no simple task, but rather the reward of arduous research. In the present volume, therefore, the author seeks through investigation of those cases in which the sense of personality is disorganized to discover a clew to its nature. In order to know human personality we must analyze it, but it must be remembered that the phenomena separated for purposes of analysis are interdependent. The various disorders of personality may be classified as organic, emotional, and intellectual. The sense of individuality in the normal body, its fluctuations dependent upon alterations in general or local sensibility, the egoistic sense in monsters and twins, show "as the organism, so the personality." Emotional manifestations peculiar to impaired nutrition, sexual aberration, and perversion of the higher instincts are found to confirm the same proposition. Intellectual vagaries of all kinds, due to sensorial derangement, hallucinations, the phenomena of hypnotism and of mysticism, furnish the corollary that ideas are only a secondary factor in changes of personality.

Regarding personality as "the highest form of psychic individuality," the nature of *consciousness* and the *individual* is involved. Instead of the subjective notion that consciousness is "a basic property of soul," M. Ribot finds it "a simple phenomenon superadded to activity of the brain, appearing and disappearing according to circumstances." States of consciousness are coincident with disassimilation of nervous tissue, so that we may predict that they depend upon a certain state of the nervous system. But we do not yet understand all of the physiological conditions of consciousness.

If *individual* be defined as that which is not divided, we are obliged to descend very low in the organic world to find an example. "Every protoplasmic mass which attains a few tenths of a millimetre spontaneously divides itself. Protoplasm in the individual state is therefore limited in size." Scientists may find a rudimentary consciousness in the unfolding, absorbing, and dividing of the lowest organism; but M. Ribot considers this an irritability common to living beings, which is developed into the general sensibility of more complex forms. In colonies of *Hydractinia*, or in *Agalmidæ*, where locomotion is centralized, we meet with a coordination which is the germ of personality. Gradually, as the nervous system becomes more prominent, psychic individuality is constituted. In any given time the sum of nervous actions in man will far exceed the sum of the states of consciousness. Thus conscious personality is but an abstract of what takes place in the nervous centers. "Why certain nervous actions become conscious, and which are they?" is yet unanswerable. Different states of consciousness succeed each other and depend upon nervous activity. Pathology confirms the fact that the feeling of the ego changes with the bodily condition. The problem thus becomes biological, and psychology must wait, therefore, for a fuller knowledge of the genesis of organisms.

STUDIES IN EVOLUTION AND BIOLOGY. By ALICE BODINGTON. London: Eliot Stock. Pp. 220. 50 cents.

A PERUSAL of this book shows extensive reading on the part of the author, and a clear conception of the principles of evolution. Some of the chapters are very interesting. It is difficult, however, to see the purposes of the book: as a help to the

working student it is far too meager, and lacks references to original material; as a popular book for the uninformed it is too condensed to be of much use. At the outset a list of books is given for consultation, and this will strike one as a curious collection for the purpose. In the preface the author says, "I am at a loss to imagine why it is considered almost wrong to write about physical science without having made original experiments." The advantage of having made original experiments leads a writer to greater exactness, and, above all, to appreciate the relative value of statements and facts. Her allusions to the fixed ascidians as being comparatively free from vicissitudes and dangers in contrast with locomotive forms derived from the same stock, is misleading. The helpless creature nibbled at by fishes, infested by extraneous growths, unable to fight or flee, is seriously handicapped in the struggle for existence.

We know of no evidence to show that the duration of life of a species is governed other than by the law of natural selection. An interesting article, by Prof. Verrell (Science, vol. i, p. 303), would have given the author some hints as to the probable cause of the rapid disappearance of the larger vertebrates in past times. An allusion is made to the divergence of the Ainos from the Japanese, whereas the Ainos covered the islands of Japan before the Japanese were crystallized into a nation.

Silly flights of fancy are quite out of place in a serious work of this nature; but the attempt to enliven a dignified discourse by lugging in extracts of poetry or nonsense is peculiarly English, and so must be endured.

The *Progress Report on Irrigation in the United States*, prepared by Special Agent *Richard J. Hinton*, on account of the shortness of time during which the survey had been at work when it was made (sixty-one days), does not include results of the investigation itself, but only the returns of correspondence with experts and persons interested in the subject, invited in order to show the conditions and development of irrigation as applied to the soil for the purposes of cultivation. The large number of letters received shows how extensive and growing is the interest in the subject, and promises that the office of the irrigation inquiry will soon have a record of all that has been done about it. As among our own people, practical irrigation appears to have begun with the Mormon settlement on the Great Salt Lake; but has been practiced by the Indians in Arizona and New Mexico for five hundred years. General irrigation really began in the United States with the foundation of the colony at Greeley in Colorado, in 1870, which was successful at once. Its development, slow till 1880, has been more rapid since then. One of the sequences of its adoption is the appearance of a tendency toward division of large holdings of land and its more or less rapid disposal in small bodies. Another incident is a movement among land, mortgage, and trust companies to form syndicates for developing the water-supply of the plains country, for the purpose, of course, of improving the security for their loans. Horticulture in California is said to be in great part the result of irrigation, as is illustrated in the great fruit farms at Riverside. Much stress is laid upon the value of the "undersheet water" of the Arkansas and Platte and other valleys, the results of the survey of which, by Chief-Engineer Nettleton, are noticed below. The curious fact is mentioned concerning this water that cultivation tends to draw it up. Thus at Fresno, where the first cultivators had to dig fifty feet for it, they now get it at from eight to twelve feet below the surface.

The *Report of Artesian and Underflow Investigation* between the ninety-seventh degree of west longitude and the foot-hills of the Rocky Mountains, presented by *Edwin S. Nettleton*, in response to a call by the Senate, is also a progress report, and relates to work done in November and December, 1890, in parts of Kansas, Nebraska, and Colorado, covering particularly the valleys of the Platte and the Arkansas. Valuable features of the report are the plan and profiles showing in detail the location and relation of the surface of the underground water, as found in rivers, wells, springs, and pools, as well as the elevation of the surface of the country along the line surveyed. There appears to be usually sufficient rainfall in this region during the whole year, if it were

properly distributed throughout the cropping season, to make agriculture reasonably certain without the aid of irrigation; and the people of the country believe that the hot and dry winds have more to do with shortages of crops than lack of rainfall. The capacity of the surface streams being limited (the Arkansas and South Platte are already made to give up most of their water before leaving Colorado), a valuable other resource for irrigation is derived from the use of the subterranean or "undersheet" water, with which the sand and gravel deposits in the river valleys of considerable width and unknown depth are charged. Much of this is obtained by means of open subflow ditches. In other cases it has to be pumped. In regions where this is not available, the people must depend upon deep wells of limited capacity, the storage and immediate use of storm waters, and the flow of artesian wells.

The Journal of the College of Science of the Imperial University of Japan, Vol. IV, Part I—published by a committee of four professors, three of whom are Japanese—contains seven articles on subjects of biology and physiology, all by Japanese writers. All are distinguished by great merit, but are of too technical a character to be susceptible of detailed notice in a popular journal. Prof. K. Mitsukari offers a study on the embryology of the turtle, in which many notable features hitherto overlooked are presented. Mr. Kamakichi Kishinonge describes the pulmonary lamellæ of certain genera of spiders and their development, which he suggests may be from some aquatic arthropod, as limulus. Mr. A. Oka describes a new species of fresh-water polyzoa. A new fungus enemy of the mulberry tree is described by Mr. Nobujiro Tanaka. The Irritability of the Stigma is shown by Mr. M. Miyoshi to have a relation to cross-fertilization. A paper by Mr. Masamaro Inaba on the Development of Suprarenal Bodies in the Mouse contains much of interest to physiologists. All these papers are abundantly illustrated in the highest style of lithographic art, with colors.

In his lecture on *Les Progès de l'Anthropologie* (Paris, De Saye & Son, printers), the *Marquis de Nadaillac* endeavors to refute the theory of evolution. It is no slight testimony to the solid foundation on which that theory has been established in our modern philosophy that so learned and earnest a writer has not been able to add one to the arguments which English students met and answered long ago.

Two studies of general interest in the *American Journal of Psychology* for April are those of Dr. E. W. Scripture on Arithmetical Prodigies and Mr. Herbert Nichols on the Psychology of Time. In his paper on Arithmetical Prodigies, Dr. Scripture first gives an account of the persons themselves, with a bibliography of the subject; and afterward undertakes to make such a psychological analysis of their powers as will help in the comprehension of them, and furnish hints to the practical instructor in arithmetic.

The most important paper in Part XVIII of the *Proceedings of the Society for Psychical Research* is that of Mrs. Henry Sidgwick on the Evidences for Clairvoyance. Other curious studies are those of Baron von Schrenck-Notzing on Thought-transference; Mr. Thomas Barkworth on Automatic Writing; and M. Léon Marrilier on Apparitions of the Virgin in the Dordogne. Prof. William James's Principles of Physiology is reviewed at length by F. W. H. Myers. London.

Dr. *William W. Parker*, of Richmond, Va., endeavors, in a paper on *Instinct in Animals and Intelligence in Man contrasted*, to show that there can be no comparison between the two, but that the matter is one of contrasts and antitheses: that in the animal, intelligence is limited; in man unlimited; that man's highest qualities or perceptions have no existence even in embryo in animals; and that "not one, not a thousand, links can bridge the chasm between the intelligence of animals and the intelligence of man."

Insects and Insecticides, a practical manual concerning noxious insects and the methods of preventing injuries, is designed by the author, *Clarence M. Weed*, who is also his publisher (Hanover, N. H.), for the use of the farmer, fruit-grower, floriculturist, and housekeeper. It has been prepared to furnish these persons with a concise account of the more important injurious insects with which they have to contend, together with a summary of the latest knowledge concerning

the best methods of preventing or counteracting the injuries of the pests. For this the author has drawn from the investigations of our leading entomologists. He has tried to make the discussions of life-histories and remedies plain and simple. The insects are classified according to the plants or parts of plants on which they ravage—as those affecting, severally, the larger fruits, the smaller fruits, shade trees, ornamental plants, and flowers, vegetables, cereal and forage crops, and domestic animals and the household. Price, $1.25.

In *Los Animales Parásitos introducidos por el Agua en el Organismo* (London, Burns & Oates) a full account is given by Dr. Rafael Blanchard of the parasitic animals introduced into the organism by water. The work is of convenient size, is neatly printed and abundantly illustrated, and will be of great value to the Spanish readers for whom it is intended.

Mr. *Edward Trevert*, author of several hand-books on electricity, batteries, and dynamos, has prepared a manual on *Electricity and its Applications*, which is published at Lynn, Mass., by the Rubier Publishing Company (price, $2). It is written to supply a demand which the author finds to exist, particularly among amateurs and students, for more information relating especially to the practical part of the science. It treats (giving facts rather than theories, and avoiding technicalities) of voltaic batteries, dynamos, the electric arc and arc lamp, electric motors, field magnets, armatures, the telegraph and telephone, electric bells, the induction coil, incandescent lamps, electrical mining apparatus, the electric railway, electric welding, plating, and gas-lighting apparatus, other electric inventions, electric measurements, and gives resistance and weight tables and an illustrated dictionary of electrical terms and phrases.

In his *Introduction to Dynamics* (Longmans) Mr. *Charles V. Burton* has included kinematics, kinetics, and statics, because of the difficulty, in writing a book for young students with no previous knowledge of the subject, of making a satisfactory division of it. Absolute systems of units have been used, and the C. G. S. system has been given the most prominent place. Price, $1.50.

In *Optical Projection* (Longmans) a treatise is given of a practical character by Mr. *Lewis Wright* on the use of the lantern in exhibition and scientific demonstration through its entire range. The author has practiced optical projection as a hobby for many years, and in his experiments has discovered many ways of improving the application of the art and enlarging its scope. His treatise is comprehensive, and includes, besides an exposition of the philosophy of projected images, descriptions of the parts of the lantern, and of the lights susceptible of being used with it, and accounts of the demonstrations of the apparatus in representations of experiments in molecular and mechanical physics, physiology, chemistry, sound, reflection, refraction, dispersion, and color of light, the spectrum, interference, polarization, heat, and electricity. Price, $2.25.

A series of studies in History, Economics, and Public Law has been begun by the University Faculty of Political Science of Columbia College, to be conducted under the editorial direction of Prof. Edwin R. A. Seligman. The monographs are to be chosen mainly from among the doctors' dissertations in political science, including only such studies as form direct contributions to science and are works of original research. They will appear at irregular intervals, and will be paged both consecutively and separately. The first of the list to appear is a study by *Walter F. Wilcox* on *The Divorce Problem*. The argument of it is that legal provisions of whatever sort have little direct and permanent influence on divorce. The whole ideal and tendency of our modern civilization are to teach every individual self-direction and self-government. No legal reform can do such work. The main work of the state should be as an educator of public opinion; and law may contribute by holding up a standard of morality in advance of the average standard. Other correctives may be sought in education and the Church, or ethical society. The second paper in the series is *The History of Tariff Administration in the United States*, from Colonial Times to the McKinley Bill, by *John Dean Goss*. The author suggests that if our tariffs had been simply for revenue the problems of the best methods and rates would have been solved long ago; but the adoption of the policy of

protection, the very logic of whose honest application compelled the taxation of an almost innumerable list of articles and the general introduction of *ad valorem* rates, vastly complicated the problem. It has brought in devices to deceive the Government, and "this seems to be the legitimate outcome of any system of *ad valorem* duties," while the introduction of the consignment system has thrown the business of importing largely into the hands of unnaturalized foreigners. But there has been, on the whole, a steady development toward more stringent supervision, regulation, and control over the importer.

The Hon. Andrew S. Draper, State Superintendent of Public Instruction of New York, desiring to get a view of the workings of the Prussian educational system from the observations of an expert, commissioned Mr. *James Russell Parsons*, Jr., an experienced officer of the public schools, on his being appointed United States consul at Aix-la-Chapelle, to examine the schools of the country and report upon them. The fruits of Mr. Parsons's observations are now published in the volume *Prussian Schools through American Eyes*, by *C. W. Bardeen*, Syracuse, N. Y.

Problems of the New Life is the title of a book of essays on social and labor questions by *Morrison I. Swift*, and published by him at Ashtabula, Ohio. The author writes with much ability from the point of view that the social organization is wrong, and a remedy is to be sought by agitation. The first paper is on The Social Ordeal of Christianity, and the burden of it is that the Church has failed to regenerate society. The ethical culture organization is contrasted with it as having recognized the progressive tendency of the time and placed itself in the current with it. In the paper on The Old and the New Life exception is taken to the attention given to mental culture as at the expense of physical development, and the accepted criterions of social esteem are decided to be wrong. Other essays concern Education and Power, The Extension of Culture, Nationalism, The Awakening of the Farmers, The Growing Revolution, etc. The conclusion of the last is that "the death of the old order is declared."

In *Politics and Property, or Phronocracy* (G. P. Putnam's Sons), a compromise is proposed by *Slack Worthington* between democracy and plutocracy. Causes are recognized for the existence of discontent and strife, but it is also seen that they can never be entirely annulled; that poverty can never be eradicated from society any more effectually than disease from the human body. But it can be ameliorated by the timely enactment of intelligent laws. The author opposes both plutocracy on the one hand and socialistic tendencies of all kinds on the other, and advocates a reasonable or conservative position between the two, which he calls Phronocracy, or the rule of reason, prudence, and understanding. He holds that the property rights of men shall, to a reasonable extent, be fully recognized and sedulously protected, but that the masses have grievances that must not be ignored. He further advocates the curtailment of the elective franchise by property and educational qualifications.

The American Citizen (D. C. Heath & Co.) is intended by the author, Mr. *Charles F. Dole*, to supply in part the growing demand for the more adequate teaching of morals in schools, especially with reference to the making of good citizens, and to show in this case the practical application of the precepts to the duties of life. It aims, not merely to state the facts about the government of our country and our social institutions, but also to illustrate the moral principles that underlie the life of civilized men. The work is intended for youth in the higher schools, and for adults who may wish to make a beginning in the study of citizenship; and the author hopes to leave such an impression as to lead his more thoughtful readers to take up a more thorough course of study.

The publication (by Macmillan) of the Encyclopædia Britannica's article on *War* in a separate volume gives the author, Colonel *F. Maurice*, opportunity to insert a few remarks on the probable influence on tactics and warfare generally of the latest improvements in destructive agencies, of which the most important are smokeless powder and the introduction of "high explosives" into shells. The general effect of the former element will probably be to render a defensive position more difficult to approach, while the assailants will continue to be completely exposed to view. The effect of high explosives

will be to put it within the power of field artillery to demolish permanent fortifications in all their forms; and even field defenses, earthworks, and the like, are destined to lose much of their value from this new development. But there are inconveniences in the use of these agents that will to a certain degree compensate for the advantages their possessors will enjoy. Strategy will be affected by the application, because it will be possible to carry out great movements with less regard to the influence of fortresses than was formerly necessary. But the difficulties involved in the constant replacement of material will also seriously affect the system of supply of armies in the field. The change in tactics will tend to favor offense rather than defense. To the amended original article of the Britannica are added an essay on Military Literature—a subject which is declared to occupy a field almost unknown to most English readers—and a list of books "of which it may be useful to know the correct titles."

The little book, *Stumbling-stones removed from the Word of God* (Baker & Taylor Co.), is addressed by its author, the Rev. *Arthur T. Pierson*, not so much to those who accuse and assault the Scriptures as to believers. It is acknowledged that "even the most candid and reverent believer finds in the English Bible some difficulties or hindrances in the way of his understanding, if not of his faith." But, assuming that the error in this case lies in what he mistakes for the truth, as a mirage is mistaken for reality, or in his own vision, the true believer is advised that he "runs no risk in calmly and resolutely examining into any alleged difficulty or discrepancy in the Bible. If one encounters a supposed ghost on a dark night, the best way is to walk up to it and look it squarely in the face. To flee from a supposed apparition may leave a lingering doubt whether the ghostly illusion was a reality or not: a bold touch would have dispelled both the illusion and the doubt."

An edition of *Eight Books of Cæsar's Gallic War* is published by the American Book Company, under the editorial care of Dr. *William Rainey Harper* and Dr. *Herbert Curling Tolman*. Regarding Cæsar's Latin as not excelled by that of any Roman writer in richness and purity, and therefore as of that which most deserves to be studied, the editors have endeavored in this edition to present the facts of the language and illustrate the subject in a manner different from the traditional method. Among the new features of the edition are the indication of the first occurrence of every word by putting it in full-faced type; the insertion of "topics for study," based upon the portion read, after the several chapters; examples of inductive studies and list of topics for investigation; and others touching points of less prominent importance. A life of Cæsar, history of Gaul, Germany, and Britain, and a sketch of the method of Roman warfare, are given in the introduction in continuous narrative.

The Quarterly Register of Current History is a new publication, the purpose of which is to collect, arrange, and preserve notices of all current events of importance, as they are given in the newspapers, for future reference and information. Such matter is of the very kind that every one who would keep himself informed of current events would desire most to have at hand; and yet it is just this kind of knowledge that, immediately its day is over and the newspaper containing it is thrown away, is soonest and most irrecoverably lost. The *Quarterly Register* is intended to remedy this evil and supply the want. The first number contains a review of the whole year 1890. The succeeding numbers will give simply quarterly records. Evening News Association, Detroit, Mich. Price, $1 a year.

Geografia per Tutti (Geography for All) is the name of a fortnightly journal for the diffusion of geographical knowledge, published at Bergamo, Italy, by the Brothers Cattaneo, under the editorial direction of Prof. A. Ghisleri. It is a popular journal, intended to reach the entire reading public and keep them abreast of the latest discoveries. Among the articles in the opening number are some bearing on the interests of Italians in America, as that on New Orleans and the Italian Emigration, and one by Elisée Reclus on the Delta of the Mississippi. Sketches and portraits are also given of the famous Italian travelers, Gaetano Casati and Romolo Gessi.

A Journal of American Archæology and Ethnology, edited by *J. Walter Fewkes*, and

bearing the imprint of Houghton, Mifflin & Co., comes to us from the Hemenway Archæological Expedition. The present number, which is marked Vol. I, contains papers on A Few Summer Ceremonials at Zuñi Pueblo, with seventeen illustrations; Zuñi Melodies, with the music transcribed from the phonograph; and a Reconnaissance of Ruins in or near the Zuñi Reservation, with eleven maps, plans, and illustrations.

In *Educational Papers by Illinois Science Teachers* it is stated that science is not taught in the country schools, for two reasons. The average teacher holds a second-grade certificate, which does not represent any scientific acquirement; and the rural tax-payer is afraid that scientific instruction may cost. In larger villages and cities outside of Chicago an elementary training may be found in high-schools, and occasionally a graded science course is provided from the beginning. A Natural Science Section was formed by the Illinois State Teachers' Association in 1888. The papers published include those read at the sessions of 1889 and 1890. It is emphasized throughout that elementary science can not be taught by memorizing the zoölogical and botanical classifications of text-books. A natural object should be the first study, and generalization can be learned from the attempts to classify actual specimens. Among those easily obtainable are domestic animals, insects, common flowers, leaves, and table-salt. Elementary physics is best studied in the uses of the lever, cord and pulley, wheel, axle, and ventilation of rooms. In the closing essay upon the material for science study it is urged that the phenomena of life, as exhibited in familiar animals, are more interesting to the child than any facts of structure.

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POPULAR MISCELLANY.

Artesian Wells and their Flow.—That part of the definition of an artesian well given by the Department of Agriculture that includes all subterranean waters which, on being reached or opened from above, are found to flow by pressure to a higher level than the point of contact, is accepted by Mr. R. Ellsworth Call, in his preliminary paper on Artesian Wells in Iowa, as complete in itself and as properly defining artesian water. Artesian flows may be variable, that is, may exhibit sometimes increased and at other times decreased flows of water, but the artesian characters are still very marked. Originally all artesian waters are meteoric, that is, are all waters which reach the earth by precipitation as rain. That they shall percolate to lower strata, be included between impervious strata or layers of clay or close-textured rock, is a necessary condition. But the total water thus held in confinement has a definite relation to the catchment basin on the one hand and to the total annual rainfall on the other. It is easily seen, then, that artesian waters may vary with the season; that in dry seasons, when the wells are shallow, they will soonest show decreased flow; that in a series of years when the precipitation is far below the normal the artesian areas may entirely fail, again to present good wells when the fall of meteoric water reaches the normal or rises above it. Wells may then, in a certain sense, be temporary and still be artesian. In the case of the deep wells, those that lie far below the range of variation from causes connected with the variable factors of annual character that mark shallow wells, artesian flows are apt to be more constant; but even here there are certain variable features which show differences through longer intervals of time. No artesian basin exists anywhere, but it will be found necessary, sooner or later, to control, by mechanical means, the total flow or "output" of the several wells. The waters are bound to be exhausted in the long run if there be no well-planned governing relation between the consumption and the known sources of supply. The deepest and the largest flowing wells will sometimes be taxed beyond their "life," and then, for a time at least, they must be allowed to rest. No owner of artesian wells in the glacial districts, where the wells are shallow, can afford to allow his well to flow and the water to be wasted.

Different Effects of Denudation.—Describing the old, or abandoned, fields of the south, Prof. W J McGee spoke, in the American Association, of the different aspects presented by the results of denudation according to the situations of the fields. When the tracts are low or gently undulating, they are quickly clothed with vegetation; but when they are hilly and high, the ravines or deepened gullies invade the hill slopes and uplands, until in some cases the entire soil is washed away and the verdure-clothed surface is transformed into a glaring sand, while the bottom lands, once the most fertile of cotton fields, are clogged with the sand swept from the hills until they, too, are ruined for agriculture. The reasons for this accelerated denudation may be sought for in the relations which geologists have found to exist between the elevation and the configuration of lands, their climatal conditions, and the character of their vegetation. An area standing high above the base level for a considerable period assumes a rugose configuration. There is also a configurative characteristic of the prairie and another characteristic of the woodland, the latter being more rugose; and the geologist trained in this line of investigation can discriminate at a glance between the lands cleared of forests by human agency and those that are naturally grass-covered. The configuration of Mississippi and other parts of the southern United States indicates considerable altitude above base-level and an originally forest-covered condition. The surface slopes are too steep to withstand the action of the storms and streams when the forest covering is removed. It is true that

during the palmy days of the plantations the fields were not eroded, but that was because of the constant use of concentric cultivation, hillside ditches, balks, and other protective devices; but when the fields were abandoned the waters gathered on the hillsides, ran down the slopes, and quickly destroyed the surface. In many cases the destruction has gone so far that to check it would cost more than the value of the land; but when not too far advanced it may be checked by planting Bermuda grass on the steep slopes and locust trees about the heads of the gullies, and by other preventive measures.

The Travels of Weeds.—The term "weed" is a relative one, and, as defined by Prof. Byron D. Halsted, means "only plants that are able to assert their inborn rights above all others and wage a close warfare with man for the possession of the earth. There is nothing in structure, form, or substance that distinguishes a weed from other plants. It lives, grows, and reproduces its kind like all others of its class, and therefore the methods of migration are the same as obtain with those of its kin. The rapidity may be greater because of the dominant weed nature, but the difference is only in degree and not in kind." A large number of our worst weeds came to us from foreign countries; just how they emigrated will never be known in every case. "Some came as legitimate freight; many were stowaways. Some entered from border lands upon the wings of the wind, upon river bosoms, in the stomachs of migrating birds, clinging to the hair of passing animals, and a hundred other ways, besides by man himself. Into the New England soil and south along the Atlantic seaboard the weed seeds first took root. Also, there are wild plants of that region, with a strong weedy nature, developed into pests of the farm and garden. As civilized man moved westward the weeds followed him, reinforced by new native ones that soon vied with those of foreign blood. Not satisfied with this, the natives of the interior ran back upon the trail and became new enemies to the older parts of our land. The conditions for the development of weeds have increased with the development of our country, until now we are literally overrun. Weeds, usually as weeds, go and come in all directions, no less as tramps catching a ride upon each passing freight train than in cherished bouquets gathered by the wayside and tenderly cared for by transcontinental tourists in parlor cars."

The Scharf Library of Johns Hopkins.—The library presented by Colonel J. Thomas Scharf to Johns Hopkins University includes books, pamphlets of great value, and several hundred unpublished manuscripts. Most of the works are historical. The manuscripts include ten by James D. McCabe, formerly of the Confederate War Department; many on revolutionary history, and a large number of a miscellaneous character. Other departments consist of a collection of materials for the history of New York city and vicinity; a collection on early Missouri history; the most valuable of Thompson Westcott's books on Pennsylvania; materials on almost every phase of Maryland history, and more varied and complete materials for the history of Baltimore; a rich mass of documents on southern history, and covering the whole period of the rebellion; about three thousand "broadsides," covering many departments of Revolutionary history, and including specimens of almost every one written or printed in Maryland during the last and the early part of the present century; Confederate and Revolutionary autographs, with the letters to which they are attached, some of them interesting in themselves; and various miscellaneous articles.

Japanese Playing-cards.—The Japanese playing-cards are more distinctly original, according to Mrs. J. King Van Rensselaer, than any others, and show no marks of common origin with them. They are oblong, and are made of pasteboard, with the backs painted black. The designs seem to be stenciled, and are brightly and appropriately colored and then covered with an enamel or varnish, which makes them slippery. They are much smaller than our cards. Forty-nine in number, they are divided into twelve suits of four cards in each suit. One card is a trifle smaller than the rest of the pack, and has a plain white face, not embellished with any distinctive emblem, and is used as a "joker." The other cards are covered

with designs that represent twelve flowers or other things appropriate to the months of the year. Each card is distinct and different from its fellows, even though it bears the same emblem; and they can be easily distinguished and classified, even if they bear the same emblem, by the symbolic flowers they bear, and also by a character or letter that marks nearly every card, and seems to denote the plant that represents the month. The only month that has no floral emblem is August, and that suit is marked by mountains and warm-looking skies.

The Monkey Language.—The results of experiments in the language of monkeys are published by Prof Garner in the New Review. Most of them were made in the United States. He had long believed, he says, that each sound uttered by an animal had a meaning which any other animal of the same kind would interpret at once; and had observed, as most of us have done, that animals soon learn to interpret certain words of man and to obey them, but never try to repeat them. When they reply to man it is in their own peculiar speech. The author began his studies by visiting the zoölogical gardens of the United States and watching and listening to the monkeys in their prattle. By permission of Dr. Frank Baker, of the National Zoölogical Garden, two monkeys which had been caged together were separated and placed in different rooms. A phonograph was arranged near the cage of the female, into which she was made to speak. It was then made to repeat her "words" near the cage of the male. His surprise and perplexity "were evident. He traced the sounds to the horn from which they came, and, failing to find his mate, he thrust his hand and arm into the horn quite up to the shoulder, withdrew it, and peeped into the horn again and again. He would then retreat and again cautiously approach the horn, which he examined with evident interest. The expressions of his face were indeed a study." This satisfied Prof. Garner that the monkey recognized the sounds as those of his mate. He then managed to get some sounds from him which the mate in her turn recognized. The next recorded interviews were with two chimpanzees, from which a fine, distinct record was secured, and with a capuchin monkey in the Cincinnati garden. The author spoke to the monkey in his own tongue, using the word supposed to stand for milk. The monkey "rose, answered me with the same word, and came at once to the front of his cage. He looked at me as if in doubt, and I repeated the word; he did the same, and turned at once to a small pan in the cage, which he picked up and placed near the door at the side, and returned to me and uttered the word again. I asked the keeper for some milk, which he did not have, however, but brought me some water. The efforts of my little simian friend to secure the glass were very earnest, and the pleading manner and tone assured me of his extreme thirst. I allowed him to dip his hand into the glass, and he would suck his fingers and reach again. I kept the glass from reach of his hand, and he would repeat the sound and beg for more. I was thus convinced that the word I had translated milk must also mean water, and from this and other tests I at last determined that it meant also drink and probably thirst. I have never seen a capuchin who did not use these two words. The sounds are very soft and not unlike a flute, very difficult to imitate, and quite impossible to write." Other sounds were detected for solid food or the hunger for it, pain and sickness, and for alarm. On the utterance of the last, the monkey sprang to the highest point in his cage, and on repetitions of it became almost frantic with dread—so that the sound for food would for the time have no inducements for him. These sounds Prof. Garner regards as the constituents of a monkey language which has a variety of dialects, according to the species addressed.

Famous Japanese Swords.—A Japanese short sword exhibited by Mr. Inman Homer before the Numismatic and Antiquarian Society of Philadelphia is distinguished by an inscription on the blade. Mr. Benjamin Smith Lyman said that this inscription was in Japanese characters, and appeared to be the name of the sword. "It is not usual," he said, "for swords to have a name in Japan, but it is sometimes the case, as in Europe. Two famous swords are recorded

in Japanese history—one, called *Hizamane* (the knee-sword), from its being tried upon a convict, and at one stroke severing the knee as well as the neck; and another, called *Higekiri* (beard-cutting), from its cutting through the beard when similarly tried. Another sword is mentioned in the celebrated romance of the memoirs of the Eight Dogs of Satonú and called *Murasame* (Autumn Showers), because it had the magical property of shedding water that kept it free from blood. The sword now exhibited is inscribed with *Osoraku*, which appears to mean 'fearful,' so the sword probably bore the not inappropriate name of 'The Fearful.' Being a short sword, it has no guard, as the short sword was sometimes worn beneath the robe, where a guard would be in the way. Long swords usually have an inscription under the wooden handle, giving the name of the maker and the date. This bears none, but the maker's name is found upon the blade of the small knife inserted into the same scabbard, which is inscribed *Morju Shiro Kanekiyo*. Kanenga was the name of a famous sword-maker, some of whose works are dated from 1321–1323 A. D. A successor of his was Kaneyoshi (1492–1500), and from certain parallel inclined lines which Kaneyoshi used as a distinguishing mark, and found on the part of the present sword concealed by the handle, it seems probable that the maker, Kanekiyo, was a pupil of his, or a not very distant successor, making the sword, therefore, probably over three hundred and fifty years old."

A Chinese View of it.—The Chinese *literati* have now come to the conclusion, according to the North China Herald, of Shanghai, that Western science has been built up from the leaking out of the knowledge possessed by their ancestors to Western men, who cultivated it, improved upon it, and developed it. Hence they argue in favor of accepting foreign science and inventions in China, saying: "We wish to make use of the knowledge of Western men, because we know that what they have attained in science and invention has been through the help that our sages gave them. We have a good right to it. What Europe has done she has done through the help we gave. If we did not exactly give science to Europe, we gave it the fruitful germ which produced it. They have the science of optics, but in our Motsz we find that reflection from mirrors was known in the days of Mencius. The men of the West hold that the earth is round. This was believed also by our poet Chü Yuen, who, in his ode on astronomy, announces this doctrine; and this was not many years after Mencius. This being so, we ought not to be ashamed of the study of Western science. We are the rivals of the Western kingdoms, and it is good policy to use their spears in order to pierce their shields. We ought to train our youth in Western science, so that we may know how best to meet them in the struggle to resist their encroachments."

The Birds of the Farne Islands.—The Farne or Fearne Islands of the coast of Northumberland, England, famous by association with Grace Darling, "the wrecker's daughter," are more noted as the home of countless sea birds which resort there to nest and rear their young. The variety of their features of "cliffs, stacks, and crags, rabbit-warrens and land thickly covered with vegetation, rocks, and sloping beach," admirably adapts them for this purpose. They are not inhabited, except by the light-house keepers and their families, so that the birds and the rabbits have them all substantially to themselves. They are attractive spots to visit, and this is best done in the second week in June, when the breeding season of the birds is at its height; in addition to the eggs, which are practically countless, the visitor then has the pleasure of seeing many newly hatched birds. As "the Pinnacles" of the islands are approached, the guillemots are seen occupying in thousands the flat tops, sitting on end, and packed so closely together that to all appearance there is not room for another; "indeed, so dense are the masses, that one can not help wondering how each individual bird can recognize its own egg—for the guillemot lays but one—or, having left it, can force its way back to it again when it has recognized it, more especially as the eggs are placed on the bare rock, without the faintest vestige of a nest. They are pear-shaped, very large for the size of the birds, and the color and markings vary in

different specimens in a most extraordinary manner." Nearly every shelf or projection of the rock, both in the Pinnacles and in the rest of the islands, is occupied by the kittiwakes, whose well-built nests, with their spotted, brown eggs or speckled, downy young, can be easily seen from the tops of the cliffs. "Walking about," says a writer in the Saturday Review, "it is hard to avoid treading on the gulls' eggs, which are placed in rather loosely made nests among the coarse herbage or on the rocks themselves. As the center of the island is reached it is easy to see the nests of the cormorants, which are large, slovenly constructions, composed principally of sea-weed, mixed with pieces of drift-wood, corks off fishing-nets, and other such flotsam and jetsam, the whole covered and made filthy both to sight and smell by the droppings of the birds and remnants of fish. The eggs, which are bluish-green in ground color, are covered with a white, calcareous matter; but, except where freshly laid, look as dirty as the nests. . . . In a comfortable hollow between two rocks we find the nest of an eider duck, and then, within a very short distance, one or two more. These nests are most cozily lined with the brown down which the bird picks from her breast from time to time during the process of incubation, and in which the large, greenish-gray eggs, from five to eight in number, are almost covered." These birds are very tame and approachable. The light and peaty soil of the interior of the island is full of burrows, which are divided between numberless puffins and a few rabbits. "Many of the puffins, curious, pompous-looking little fellows, with large, brightly colored bills, may be seen sitting about on the rocks or flying and swimming round the island, while their partners are below the ground, sitting each on the solitary egg which she has laid at the end of the burrow. In the campion-covered centers of the islands the terns are numberless, and the beach down to high-water mark is covered with their eggs, so that very great care has to be used in walking to avoid treading on them. They are also to be found in large numbers among the sea campion; many are laid on the shingle with little if any pretense of a nest; while others have slight nests, made of bents and pieces of sea-weed. The list of birds breeding on the Farne Islands includes twelve species, and others may be occasionally seen there as visitors. The birds and eggs, which had been exposed to danger of destruction and extermination, have had their existence more and more secured under the wild birds' protection acts passed since 1869; and in 1888 an association of gentlemen interested in ornithology was formed, which has secured a lease of the islands, keeps intruders off, and takes care of the birds.

Wild Life in the Snow.—Snow, remarks in the London Spectator an observer of wild life, generally catches our animals unprepared, and they are put to all kinds of shifts to find food and escape their enemies. The more open and exposed the districts, the greater their difficulties. Where there are thick woods and hedgerows, and, above all, running water, birds and beasts alike can find dry earth in which to peck and scratch, or green things to nibble and water to drink. But on the great chalk downs a snow-storm seems to drive from the open country every living creature that dares to move at all. For the first day after a heavy fall, the hares, which allow the snow to cover them, all but a tiny hole made by their warm breath, do not stir; only toward noon, if the sun shines out, they make a small opening to face its beams, and perhaps another in the afternoon, at a different angle to the surface, to catch the last slanting rays. But soon hunger forces the hares to leave their snug snow-house, and they find their way to the cabbage or turnip gardens. Squirrels, which are often supposed to hibernate, retire to their nests only in very severe and prolonged frosts. A slight fall of snow only amuses them, and they will come down from their trees and scamper over the powdery heaps with immense enjoyment; what they do not like is the snow on the leaves and branches, which falls in showers as they jump from tree to tree, and betrays them to their enemies, the country boys. During a mild winter they even neglect to make a central store of nuts, and, instead of depositing them in big hoards near the nest, just drop them into any convenient hole they know of near. Rabbits also seem to enjoy the snow at first. They

require a dry, bracing atmosphere, and sea-breezes and frosts suit them; and in the morning after a snow-fall their tracks show where they have been scratching and playing in it all night. But after a deep fall they are soon in danger of starving. If there is a turnip-field near, they will scratch away the snow at the roots and soon destroy the crop; if not, or if the surface of the snow is frozen hard, they strip the bark from the trees and bushes. While all the harmless animals are obliged to spend the greater part of the day and night seeking food, their enemies profit exceedingly. The stoats and weasels find that they have only to prowl down the stream-side to catch any number of thrushes and soft-billed birds which crowd the banks where the water melts the snow, and little piles of feathers and a drop or two of red on the snow show where the fierce little beasts have murdered here a redwing and there a water wagtail, or even a water-hen. Water-shrews, water-rats, and otters all dislike frost and snow, more, perhaps, because the streams are frozen and food is more difficult to obtain along the banks, than from any inconvenience the snow causes them. Otters, even if the rivers do not freeze, have a difficulty in finding the fish, which in cold weather sink into the deepest pools, and in case of some species burrow in the mud. So they go down to the sea-coast for the cold weather, and, making their homes in the coast caves or old wooden jetties and wharves, live on the fish of the estuaries. Rats also often emigrate to the coast in snow-time and pick up a disreputable livelihood among the rubbish of the shore. Of all effects of weather, snow makes the greatest change in animal economy in the country-side, and weeks often pass before the old order is restored.

Where Women rule.—At the opening of a paper on the political domination of women in Eastern Asia, Dr. Macgowan refers to the condition of the aboriginal peoples whom the Chinese found on Yellow River on their arrival from Akkad. The Chinese then possessed the rudiments of civilization, of which the aboriginals were then destitute. That this irruption of the Chinese was anterior to the invention of cuneiform writing in Akkad was probable, because of their use of *quipos* or knotted cords in keeping records. These *quipos*, the author said, and not mere tradition, were the base of Chinese archaic annals, and from them the earliest form of Chinese written characters was evolved. Anterior to these *quipos*, judging from certain neighboring tribes, notched sticks were employed. As to the tribes which the Chinese found existing when they reached their future home, the philosopher of Universal Love, Motzu, enunciated views on the evolution of the state and family which are in accord with those of modern anthropologists. Men at first were in the lowest state of savagery; there was no golden age, as depicted by sages and political philosophers, until men felt a necessity of a remedy for the anarchy that prevailed. Some of the practices of self-deformation were remarkably curious—as, for instance, those of drinking through the nostrils, extracting front teeth and substituting dogs' teeth, head-flattening, etc.; the most striking was the attempt to raise a polydactylous race, by destroying all children who came into the world with the usual number of fingers and toes. The author described a number of instances of rule by Amazons, and observed that it is mostly among the aboriginal inhabitants that the chieftaincy of women obtains to this day. There is seldom an age of which one tribe or another does not afford examples; the more primitive the condition of these tribes the slighter is sexual differentiation as regards public governmental affairs. The fables and myths in Greece respecting Indo-Scythian Amazons arose chiefly from rumors respecting tribes of this kind.

The Yourouks.—The Yourouks of Asia Minor, according to a paper by Mr. H. Theodore Bent in the British Association, are a fair race of nomads of Tartar origin, from the north of Persia. They wander on regular lines of pasturage, live in goat's-hair tents, occasionally showing a tendency to sedentary life, and build miserable hovels out of the ruins of the cities. The Yourouk has very little religion, and refuses to adopt the measures desired by the Turkish Government. The people have sacred trees hung with rags, say prayers over their dead, and practice circumcision, but do not carry out

the elaborate system of prayers and washing inculcated by the Koran. They are polygamous, and have wives, or rather slaves, each having her separate occupation in the family life—one minding camels, another the flocks, another the tent arrangements, etc. They have regular communication with the outer world. Greeks from the towns lend money to start them in flocks by what is called an "immortal contract." Merchants for wool and cattle pay regular visits to the different encampments. Tinkers, the public circumciser, and other periodical visitors go among them spring, summer, and winter. Their utensils are principally of wood—wooden mortars, wooden gloves for reaping, wooden musical instruments, etc., are used. They are clever at getting food from mountain plants and herbs. An excellent substitute for coffee is produced by a species of thistle; and a sweet, somewhat like chocolate cream, is made out of the cone of a juniper tree. Formerly they were very clever in making dyes from mountain herbs, but the introduction of aniline dyes has greatly destroyed their taste.

Animals in the Desert of Gobi.—In respect to its fauna, the Desert of Gobi constitutes a zoölogical district by itself, without its animal world being rich in species. Animals may be found in considerable groups in certain places, as in the mountains and along the rivers and lakes, but they are comparatively rare in the desert itself, where one meets hardly anything but innumerable lizards gliding under his feet. Birds as well as quadrupeds lead a nomadic life, being forced to seek food at places a considerable distance apart. The animals of the desert are, however, not very particular, especially with respect to drink, and some of the small mammals probably do not drink, but satisfy themselves with succulent plants, or the little snow that falls in winter. Among the mammals the wild horse and camel and the argali sheep are worthy of mention. Prejevalsky discovered in Zungaria the horse which has been called by his name, the Kirghiz *kantag*, the Mongol *maké*. It lives in the most inhospitable regions, in groups of five or six individuals. While the existence of a wild horse in central Asia was unknown till the present time, it has been understood from the days of Marco Polo that a wild camel lived there; but none of the authors who have mentioned it, on the authority of the Chinese, had ever seen it, and its existence was doubted by Cuvier. It also was seen by the Russian explorer in the neighborhood of Lake Lob and the Desert of Zungaria. The camel prefers sandy spots more or less inaccessible to man. It spreads over a considerably larger area than the wild horse; for, while the latter is cantoned in a single locality of Zungaria, it inhabits the lower Tarrin, the country of Lake Lob, Khami, and the Thibetan Desert of Zäidam. Prejevalsky calls this animal the wild Bactrian camel. While the domestic camel is usually timid, stupid, and indolent, the Gobi camel is distinguished by its vigilance and the extraordinary development of its senses of sight, hearing, and smell. It can run a hundred kilometres without stopping a moment, and can climb mountains with an agility comparable to that of the chamois. Its voice is rarely heard, but is more like that of the bull than that of the domestic camel. The argali sheep is common in the mountainous parts of the Gobi, whence it descends in the spring to feed on the herbage. It adheres to the places it has once chosen, and a mountain spur is often the permanent abode of a whole flock. As it is not troubled by the natives, it has not yet become afraid of man, and passes indifferently by the Mongol camps on its way to water. Among the carnivorous animals of the Gobi are the tiger and the wolf, but the bear has not been seen there, although it is found in the Thian Shan Mountains.

Stolidness of Eskimos.—One of the most remarkable peculiarities of the Eskimos of Cape Prince of Wales, as described by Mr. H. F. Payne, of the Meteorological Office, Toronto, is their sensitiveness to ridicule. It is necessary to put on the gravest expression in dealing with them, else they will refuse to work for or with you, and sulk. While, as a rule, the Eskimo looks upon the white man as born to do him favors, those the author met would sometimes offer payment for their services. If an Eskimo was given an unusually valuable present, he would immediately turn round and ask for the most impossible things, as though he thought

you were now in a good humor and it was the time to get all he could from you. As far as it could be seen, it appeared to be the general belief that all property, especially in the way of food, belonged to everybody in common, and therefore, if you held more than another, it was only because you and your family were physically strong enough to protect it. Few men would, of course, steal from one another when food was plentiful, and thereby make enemies for themselves; "but when food is scarce, might is right," and all make note of the position of their neighbors' *caches* before the winter snow covers them. The Eskimos are exceedingly free, and never consider a man their superior unless he or his family are physically stronger or are better hunters than they. These superior men are treated with little deference, though they are usually sought for in the settlement of difficulties, and act as public executioners.

Central Asian Phenomena.—M. Gabriel Bonvaldt and the Prince Henri of Orleans were received by the Geographical Society of Paris on the last day of January, on the occasion of their return from a journey through the heart of central Asia from the frontiers of Russian Turkistan to Tonquin. They claim to have discovered ranges of mountains, lakes, extinct volcanoes, geysers, and a pass at a height of 6,000 metres, never before explored. Yaks, antelopes, wild horses, and other animals were numerous below 5,000 metres, but birds had disappeared, and there was no vegetation. The travelers and their men and animals suffered greatly from "mountain-sickness." The party went by what is called "the little road" from Thibet to China, which they believed had never been explored. They found well-wooded valleys full of game—meeting twenty-one bears in three days—and often well cultivated and studded with villages; and they crossed the upper waters of several of the rivers of eastern Asia, including, as they supposed, the Yang-tse-kiang. Among the more important features of the country was a hitherto unknown volcanic region. Two isolated volcanoes were named the Pic de Paris and Mont Réclus. A group of other volcanoes gave them reminders of the craters of Auvergne, appearing like tunnels with a small cone in the center. Lava-blocks were numerous, some of them being two cubic metres in dimension. From a distance they might have been taken for yaks. Hot sulphur springs and frozen geysers were numerous. Many minerals were found, including iron and lead. Curious gray monkeys with long hair and short tails were found living among the rocks at the foot of Mont Duplex, but nowhere else.

The Future of the Lobster-fishery.—The experiments begun a few years ago for improving the lobster and cod fisheries of the coasts of Newfoundland promise to be successful. Besides 15,000,000 lobsters hatched and placed in the waters at the Dildo hatchery, 432 floating incubators have been established, at which more than 390,000 lobsters have been hatched. All these would have been lost except for these operations. Lobsters arrive at maturity in five years; and if the useful work now going on is continued year after year, it is evident that the threatened destruction of the lobster can be averted, and the stock in the waters maintained and extended. The cod-hatchery has not been quite so successful, but still the results have been very satisfactory. Fishermen in the neighborhood of Trinity Bay are said to have recently observed large shoals of small cod, which they have not noticed before, from one to two inches long; and this, it is claimed, would be the present size of the fry placed in the waters in June and July last.

NOTES.

A REMARKABLE meteor, found in Arizona, was described by Prof. A. E. Foote, in the Geological Section of the American Association. It was extraordinarily hard, so that a number of chisels were destroyed in cutting it, and the emery wheel used in polishing it was ruined. Cavities were reached in cutting it, which were found to contain diamonds, small and black, and of little commercial value, but of the greatest mineralogical interest. Granules of amorphous carbon were found within the cavity, in which a minute white diamond was revealed by treatment with acid. The general mass of the stone contained three per cent of nickel. Diamonds were previously observed in a meteorite by two Russian mineralogists in 1887.

In the Anthropological Section of the American Association, Mr. William H. Seaman read a paper on the Essentials of Education, with a new classification of knowledge, in which he set forth the changes or modifications in present systems of education required to adapt them to modern ideas. Mr. Walter Hough described the custom of cava-drinking among the Papuans and Polynesians; Major Powell exhibited his linguistic map of North America; Mr. Thomas Wilson described the jade implements from Mexico and Central America, and a collection of ancient gold ornaments from the United States of Colombia; Mr. J. Owen Dorsey discussed the onomatopous types and phonetic types of the Siouan languages; Mr. J. H. Perkins described a collection of stone pipes from Vermont; and Mr. M. M. Snell enforced the Importance of the Science of Comparative Religion.

A connection between tariffs and the distribution of life in the districts which they effect has not hitherto been supposed, but, according to the late D. H. Graham, of Iona, it was free trade brought the rooks to that island. Thus: "Since the ports were opened to the importation of foreign cattle, the rearing of black cattle has been abandoned in those parts of the Highlands; consequently sheep have taken their place, and in Iona, where two years ago you could hardly find a sheep, now you will see scores of them; and whereas two years ago not a rook came to the island, now the hill-pastures are black with them."

A curious trial has recently taken place in London, in which an American named Pinter was prosecuted for an attempt at cheating by pretending to manufacture gold. The accused man set up in defense that he really possessed a secret by which he could increase the bulk of a mass of gold. It was alleged by the prosecution that he once did increase a piece of gold by placing a black powder in a crucible, and it was asserted that the powder must have contained gold. The accused asked the magistrate if he had ever known gold to float. Some of the powder being tested on water floated. This result was afterward said to have been produced by mixing lampblack with the powder and making it too greasy to sink quickly. The accused pretends to more power than the old alchemists, for they only assumed to turn other substances into gold, while he pretends to make it outright.

Dr. Carl Peters relates in his book on Africa that he came to a place where the natives on one bank of a broad river communicate with those on the opposite side by speaking with voices hardly raised, "and yet each side can perfectly hear what the other says." Dr. Peters says that Bishop Hannington was killed, not because he was a Christian, but because he insisted on approaching Uganda from the east. The Waganda have an old prophecy according to which an expedition from the east is to "eat up" the land and make an end of the dynasty of the Wakintu. Accordingly the approach from the east has been strictly forbidden.

The Philadelphia Zoölogical Gardens were visited during the year ending in April last by 211,884 persons, or 3,719 fewer than visited them in the previous year; giving an average of 581 daily admissions. The superintendent's report embodies the important remark that the attention of all institutions devoted to zoölogical pursuits is being directed more strongly each year to the rapid destruction of many of the more valuable and important animals of our native fauna, and to the need for immediate adoption of every means that can be employed to save them from complete extinction. In furtherance of this object increase in the capacity of zoölogical gardens is important, in order that room and facilities may be provided for their increase and growth, secure against improper crossing and inbreeding.

Besides the active enemies which are continually seeking to destroy earth-worms, these animals have a habit of seeking destruction on their own account. On any wet morning the shallow puddles in the roadways and elsewhere are often occupied by the dead bodies of earth-worms, or by individuals at their last gasp. Have these worms voluntarily sought a watery grave? or do they represent, as Darwin thought, merely the sickly and dying individuals that have been washed out of their burrows by the rain? Darwin's explanation is probably true, but it is also credible that the heating of the puddles by the sun's rays has something to do with the great mortality of the annelids. Cold fresh water seems to be practically harmless, though salt water is rapidly fatal to earth-worms.

An illustrated account of the drawings of aboriginal origin that are found in caves in different parts of the United States, prepared for Appletons' Annual Cyclopædia for 1889, has been sent us in a separate pamphlet by the author, Mr. T. H. Lewis. The designs include figures conventionalized from the forms of man, the hand, fishes, serpents, an elk, a face, birds, and combined figures. It is suggested by the editor of the Annual Cyclopædia that one of them may be intended to represent a family or tribal ensign.

In a paper read before the Medical Society of Virginia, Dr. W. W. Parker, of Richmond, favors burial rather than cremation on grounds of convenience and economy; natural sentiment, whereby we cling to every vestige of the body in which dwelt the soul of the dear one; the sentiment of affection, which wants to know the exact spot where the body lies; and religious motives.

THE reports of the United Kingdom Temperance and General Provident Institution are regarded by Dr. J. J. Ridge as affording evidence of increasing weight and conclusiveness to the value of temperance as a factor in longevity. For the last year the actual claims upon the Institution for relief were, in the temperance section, 71·06 per cent; in the general section, 100·2 per cent of the expected claims. A summary of five quinquennial returns, or for twenty-five years, shows that while in the general section the deaths have fallen short of the expected number by 242, in the temperance section the deaths are 1,470 fewer. The fact that in the general section the deaths are below the healthy male average proves that the difference between the two sections is not due to excessive drinking on the part of any considerable number of the general section. The comparison is therefore fairly between abstainers and moderate drinkers, and goes to show that the use of alcoholic liquors produces degeneration of the tissues and shortens life.

SOME habits of crocodiles are described by M. Voeltzkow, who observed the animals in Vituland. Seventy-nine newly laid eggs were obtained from a spot six paces in diameter which had been cleared of plants, apparently by the crocodile having wheeled round several times. The eggs lay in four pits, dug in the hard, dry ground, about two feet obliquely down. According to the natives, the crocodile, having selected and prepared a spot, makes a pit in it that day, lays twenty or twenty-five eggs in it, and covers them with earth. The next day, it makes a second pit, and so on. It remains in the nest from the beginning, and sleeps there till the young are hatched, in about two months, at the setting in of the rainy season.

A PAPER by Prof. William Frear, in the American Chemical Association, dealt with differences in composition in the European and the American chestnut. European chestnuts transplanted to this country lose their peculiarities in some degree, but American chestnuts also exhibit wide differences in different years.

THE question of the relative influence of animal and vegetable diet on the animal temperature has never, according to the Lancet, been investigated in the human species on a sufficiently comprehensive scale to be of any value; but such comparative facts as throw light on the matter tend to indicate that vegetable feeders, among the lower creation, have a high temperature. The evidence, however, does not seem to be uniform to this point, and it is suggested that some of the apparent discrepancies may be due to the nature of the clothing of the skin. A correspondent of the Lancet and his wife have for about three years been living chiefly on fruit and vegetables, with a little milk and its products, eggs and cheese, and without alcohol, and find that they live as healthily as before, at a lower expenditure of energy. If it be proved that a minimum of animal diet will support life efficiently under reduced combustion and reduced waste of material, "a valuable as well as curious fact will be added to our practical knowledge."

THE limit of a man's power to do without sleep has been the subject of curious experiments. Lord Brougham once tried it on himself, and, beginning Monday morning, kept awake till Tuesday night, when he fell asleep on seating himself while trying to dictate to an amanuensis. The recent competition of six men in Detroit, in trying to postpone sleep for seven days, is in point. Beginning on Monday noon, March 30th, four of the men failed before Thursday. A fifth kept up till Sunday morning, had a hard struggle with his sleepiness all through the day, and succumbed at midnight. The sixth completed the time and was conducted to the stage and introduced to the spectators, but was sound asleep before the introduction was over. It is said, however, that these men were allowed to sleep in fifteen-minute naps at the end of their several vigils, and it is added that they suffered no permanent ill.

ACCORDING to Brandis's Wald in der Vereinigten Staaten von Nord America, forest vegetation is much richer in North America than in Europe, and comprises 412 species—of which 176 are native to the Atlantic region, 106 to the Pacific, 10 are common to both, 46 to the Rocky Mountain region, and 74 are tropical species near the coasts of Florida—as against 158 species in Europe. Six North American species of forest trees—the red-bud or Judas tree, persimmon, hackberry, plane tree, hop hornbeam, and chestnut—are also indigenous in Europe, all now growing there naturally south of the Alps. And since many American forest genera existed in Europe in Tertiary times, while only five European forest genera (*Ceratonia*, *Laburnum*, *Olea*, *Syringa*, and *Laurus*) are not found in America, it is possible that other species formerly common to both countries were destroyed in Europe north of the Alps by the Glacial epoch.

A PARLIAMENTARY report shows that ether is now used to a considerably large extent in Ireland to produce intoxication. It is preferred to whisky because it is cheaper and more effective. Its effects are described as arousing combative instincts and producing a high state of exhilaration accompanied by shouting and singing and the use of provocative words. Even children are accustomed to it, and come to school smelling of it.